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Article

The Impact of Teacher Feedback on Student Motivation in Online Learning Environments: A Study Based on Self-Determination Theory

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Abstract: This study investigates the impact of teacher feedback on students' learning motivation, self-efficacy, and engagement in online learning environments. Grounded in Self-Determination Theory (SDT), the research explores how different types of feedback — cognitive, affective, and metacognitive — satisfy students' psychological needs for autonomy, competence, and relatedness. A mixed-methods approach was employed, combining quantitative experimental data with qualitative interview insights. The findings reveal that affective feedback significantly enhances emotional engagement and self-efficacy, while metacognitive feedback promotes self-regulated learning and long-term retention. Cognitive feedback, though effective in improving task performance, has a limited impact on motivation unless paired with emotional or metacognitive elements. The study also highlights the importance of timely, personalized, and multimodal feedback in online education. These results provide practical implications for educators and online learning platforms, suggesting that optimizing feedback strategies can significantly improve student outcomes. The study contributes to the literature by integrating SDT with empirical research on feedback in online education, offering a framework for designing feedback practices that address students' psychological needs.

Keywords: teacher feedback; learning motivation; self-determination theory (SDT); online learning; self-efficacy; learning engagement; mixed-methods research

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1. Introduction

1.1. Background of the Study

In recent years, with the rapid advancement of information technology, online education has become a significant component of the global educational landscape. Online education not only breaks the constraints of time and space but also provides learners with more flexible and personalized learning experiences. However, despite its advantages in technical support and resource accessibility, the effectiveness of online education still faces numerous challenges, one of which is how to effectively sustain and enhance students' learning motivation.

Feedback is a critical element of teacher-student interaction in the learning process, exerting a profound impact on students' learning motivation and academic performance. Research indicates that timely, specific, and constructive feedback can help students clarify learning goals, adjust learning strategies, and boost their confidence. Especially in online learning environments, where face-to-face interaction between teachers and students is absent, the role of feedback becomes even more crucial. However, current re-

search on feedback primarily focuses on traditional classroom settings, with limited exploration of the impact of feedback types on students' learning motivation in online education.

Self-Determination Theory (SDT) provides a vital theoretical framework for understanding learning motivation. The theory posits that human behavioral motivation stems from the satisfaction of three basic psychological needs: autonomy, competence, and relatedness. In educational contexts, teacher feedback can influence students' intrinsic motivation and learning engagement by fulfilling these psychological needs. Nevertheless, existing research predominantly focuses on the impact of feedback on academic performance, with less attention paid to how feedback satisfies students' psychological needs to enhance their learning motivation, particularly in online learning environments.

Despite the widely recognized importance of feedback, current research still has several limitations. Firstly, the specific effects of different feedback types (e.g., cognitive feedback, affective feedback, and metacognitive feedback) on students' learning motivation have not been thoroughly explored. Secondly, existing studies primarily focus on the content of feedback, paying less attention to the manner of feedback delivery (e.g., timeliness, frequency, and personalization) and its impact on students' psychological needs and learning motivation. Additionally, empirical research on the effectiveness of feedback in online education remains scarce, limiting a deeper understanding of how to optimize feedback strategies. Therefore, this study aims to address these gaps by investigating the mechanisms through which teacher feedback influences students' learning motivation in online learning environments and proposing strategies to optimize feedback practices based on Self-Determination Theory [1].

1.2. Statement of the Problem

While the importance of feedback in enhancing learning outcomes is well-documented, its specific role in online learning environments remains underexplored. In particular, there is a lack of comprehensive understanding of how different types of teacher feedback influence students' learning motivation, self-efficacy, and engagement in online settings. This study seeks to address the following research questions:

1) How does teacher feedback in online learning environments influence students' learning motivation?

This question aims to explore the mechanisms through which feedback affects students' intrinsic and extrinsic motivation, particularly in the context of online education where direct teacher-student interaction is limited.

2) Which types of feedback (cognitive, affective, or metacognitive) are more effective in promoting students' self-regulated learning?

Cognitive feedback focuses on task performance and understanding, affective feedback addresses emotional states and encouragement, and metacognitive feedback targets students' awareness and regulation of their learning processes. Understanding which type is most effective can help optimize feedback strategies.

3) Can teacher feedback enhance students' self-efficacy and learning engagement in online environments?

Self-efficacy refers to students' belief in their ability to succeed, while learning engagement reflects their level of involvement and effort. This question examines whether feedback can positively influence these psychological and behavioral outcomes.

By addressing these questions, this study aims to provide a deeper understanding of the role of feedback in online education and offer practical insights for educators to design more effective feedback strategies.

1.3. Research Objectives

The primary objectives of this study are as follows:

1) To analyze the mechanisms through which teacher feedback influences students' learning motivation in online learning environments.

This involves examining how different feedback types and delivery methods impact students' intrinsic and extrinsic motivation.

2) To explore the effectiveness of cognitive, affective, and metacognitive feedback in promoting self-regulated learning.

The study will compare the outcomes of these feedback types to identify which is most effective in fostering students' ability to manage their own learning.

3) To investigate the impact of teacher feedback on students' self-efficacy and learning engagement.

The study will assess whether feedback can strengthen students' confidence in their abilities and increase their active participation in learning activities.

4) To provide evidence-based recommendations for optimizing feedback strategies in online education.

By integrating findings with Self-Determination Theory, the study aims to offer practical guidance for educators and online learning platforms.

1.4. Significance of the Study

This study holds both theoretical and practical significance.

1.4.1. Theoretical Contributions

The study contributes to the field of educational psychology by integrating Self-Determination Theory with feedback research, providing a deeper understanding of how feedback influences learning motivation in online environments.

It addresses gaps in the literature by examining the differential effects of feedback types and their impact on self-regulated learning, self-efficacy, and engagement.

1.4.2. Practical Implications

For online education platforms, the findings can inform the design of feedback mechanisms that enhance student motivation and engagement.

For educators, the study offers actionable insights into how to tailor feedback to meet students' psychological needs and promote effective learning.

For policymakers, the research highlights the importance of feedback in online education and supports the development of training programs for teachers to improve their feedback practices.

1) Broader Impact

By improving feedback strategies, this study has the potential to enhance the overall quality of online education, making it more effective and accessible for learners worldwide.

2) Literature Review

The literature review provides a theoretical foundation for the study by examining key concepts and existing research related to online education, feedback, and learning motivation. It is organized into subsections to ensure a comprehensive exploration of the topic.

2. Literature Review

2.1. The Development and Current State of Online Education

Online education has undergone significant growth over the past two decades, driven by advancements in technology and the increasing demand for flexible learning opportunities. The rapid shift to digital learning platforms further accelerated its adoption, making it a mainstream mode of education globally. Key characteristics of online education include:

1) Flexibility and Accessibility: Online learning allows students to access educational resources anytime and anywhere, breaking geographical and temporal barriers.
2) Personalization: Adaptive learning technologies enable tailored learning experiences based on individual needs and progress.
3) Challenges: Despite its advantages, online education faces issues such as low student engagement, lack of direct interaction, and difficulties in maintaining motivation.

Research highlights that the success of online education largely depends on effective instructional design and teacher-student interaction, with feedback playing a critical role in bridging the gap between learners and educators.

2.2. The Role of Feedback in Education

Feedback is a cornerstone of effective teaching and learning. It provides students with information about their performance, helping them identify strengths and areas for improvement. This section delves into the definition, types, and impact of feedback.

2.2.1. Definition and Classification of Feedback

Feedback is generally defined as information provided by an agent (e.g., teacher, peer, or self) regarding aspects of one's performance or understanding. It can be classified into several types based on its content and purpose:

1) Cognitive Feedback: Focuses on the accuracy and quality of task performance, providing information about what was done correctly or incorrectly.
2) Affective Feedback: Addresses students' emotional states, offering encouragement or support to boost confidence and motivation.
3) Metacognitive Feedback: Aims to develop students' awareness and regulation of their own learning processes, helping them plan, monitor, and evaluate their learning strategies.

2.2.2. The Impact of Feedback on Learning Motivation

Feedback has a profound influence on students' learning motivation. According to Self-Determination Theory, feedback can satisfy students' basic psychological needs for autonomy, competence, and relatedness, thereby enhancing intrinsic motivation. For example:

1) Autonomy-Supportive Feedback: Encourages students to take ownership of their learning, fostering a sense of control and independence.
2) Competence-Enhancing Feedback: Helps students build confidence in their abilities by highlighting their progress and achievements.
3) Relatedness-Promoting Feedback: Strengthens the connection between teachers and students, creating a supportive learning environment.

2.2.3. Feedback in Online Learning Environments

In online education, feedback is particularly important due to the lack of face-to-face interaction. Research suggests that timely and personalized feedback can mitigate feelings of isolation and enhance engagement. However, challenges such as delayed feedback and generic responses often reduce its effectiveness. Studies also highlight the need for diverse feedback formats (e.g., text, audio, video) to cater to different learning preferences [2].

2.3. Self-Determination Theory and Learning Motivation

Self-Determination Theory is a widely recognized framework for understanding human motivation. It posits that individuals are driven by three innate psychological needs: autonomy, competence, and relatedness. In educational contexts, this theory has been

used to explore how teaching practices, including feedback, influence students' motivation and engagement.

1) Autonomy: Refers to the need to feel in control of one's actions and decisions. Autonomy-supportive feedback encourages students to take initiative and make choices in their learning.
2) Competence: Involves the need to feel capable and effective in achieving goals. Feedback that highlights progress and provides constructive guidance can enhance students' sense of competence.
3) Relatedness: Reflects the need to feel connected and valued by others. Feedback that fosters a sense of belonging and support can strengthen students' emotional engagement [3].

2.4. Gaps in Existing Research

Despite the growing body of literature on feedback and learning motivation, several gaps remain:

1) Limited Focus on Online Education: Most studies on feedback have been conducted in traditional classroom settings, with insufficient attention to online learning environments.
2) Underexplored Feedback Types: While cognitive feedback has been widely studied, the effects of affective and metacognitive feedback on learning motivation are less understood.
3) Lack of Integration with Self-Determination Theory: Few studies have explicitly linked feedback practices to the psychological needs outlined in Self-Determination Theory, particularly in online contexts.
4) Insufficient Empirical Evidence: There is a need for more experimental and longitudinal studies to establish causal relationships between feedback and learning outcomes.

These gaps highlight the need for further research to deepen our understanding of how feedback can be optimized to enhance learning motivation in online education.

3. Research Methodology

3.1. Research Design

The study adopts a mixed-methods research design, combining quantitative and qualitative approaches to address the research questions. This design allows for a deeper exploration of the relationships between feedback types and learning outcomes while capturing participants' subjective experiences.

Quantitative Component: Involves experimental research and surveys to measure the effects of different feedback types on learning motivation, self-efficacy, and engagement.

Qualitative Component: Includes semi-structured interviews to gain insights into students' perceptions and experiences of receiving feedback in online learning environments.

3.2. Participants

The study targets university students enrolled in online courses. The rationale for selecting this population is as follows:

University students are likely to have experience with online learning platforms, making them suitable participants for this study.

They represent a diverse group in terms of academic backgrounds and learning preferences, providing a broad perspective on the research problem.

Sample Size:

1) A total of 200 students will be recruited for the quantitative phase (survey and experiment).

2) A subset of 20 students will be selected for the qualitative phase (interviews).

Sampling Method:

1) Convenience Sampling: Participants will be recruited from online courses offered by the researchers' institution.
2) Purposive Sampling: For interviews, participants will be selected based on their responses to the survey to ensure a range of perspectives.

The experimental design, including task descriptions and feedback examples, is detailed in Appendix A. This includes the materials used in the pre- and post-test phases, as well as the specific feedback types (cognitive, affective, and metacognitive) provided to participants.

3.3. Data Collection Methods

3.3.1. Quantitative Data Collection

The study utilized three main measurement tools: The Learning Motivation Scale, the Self-Efficacy Scale, and the Learning Engagement Scale. Detailed descriptions of these scales, including example items, are provided in Appendix B. Additionally, the semi-structured interview protocol used in the qualitative component of the study is included in Appendix C.

Experiment: Participants were randomly assigned to one of four groups: three experimental groups receiving different types of feedback (cognitive, affective, or metacognitive) and a control group receiving no feedback. The feedback types, examples, and their intended purposes are summarized in Table 1.

Table 1. Experimental Groups and Feedback Types.

Group	Feedback Type	Feedback Example	Purpose of Feedback
Experimental Group 1	Cognitive Feedback	"Your answer is correct, but you could provide more details in your explanation."	To improve task performance and understanding.
Experimental Group 2	Affective Feedback	"Great effort on this task! Your hard work is paying off."	To provide emotional support and encouragement.
Experimental Group 3	Metacognitive Feedback	"Think about how you approached this task. What strategies worked well?"	To promote self-regulation and learning strategies.
Control Group	No Feedback	N/A	To serve as a baseline for comparison.

The experiment was conducted over a period of four weeks, with feedback provided weekly based on participants' performance in an online learning task. Pre- and post-tests were administered to measure changes in learning motivation, self-efficacy, and engagement.

Survey: A structured questionnaire will be administered to all participants to collect data on their perceptions of feedback and its impact on their learning.

The questionnaire will include scales to measure learning motivation, self-efficacy, and learning engagement.

3.3.2. Qualitative Data Collection

Qualitative data will be collected through multiple methods to gain a comprehensive understanding of participants' experiences and perceptions of feedback in online learning. The primary methods include:

1) Semi-Structured Interviews

Semi-structured interviews will be conducted with a subset of participants to explore their experiences and perceptions of feedback in online learning.

Focus of Questions**:** The interview questions will focus on understanding how feedback influenced participants' motivation, confidence, and engagement in the online learning environment.

Data Collection Process: Interviews will be audio-recorded to ensure accuracy, and the recordings will be transcribed verbatim for detailed analysis.

Purpose**:** This method aims to provide in-depth insights into participants' personal experiences and perspectives, complementing quantitative data collected in other sections of the study.

2) Focus Groups (Optional)

If needed, focus group discussions may be conducted to gather collective perspectives on feedback in online learning.

Focus of Discussions: Participants will be encouraged to share their experiences, challenges, and suggestions related to feedback.

Data Collection Process**:** Discussions will be recorded and transcribed for thematic analysis.

Purpose**:** This method will help identify common themes and diverse viewpoints among participants.

3) Open-Ended Surveys (Optional)

Open-ended survey questions may be used to collect additional qualitative data from a larger group of participants.

Focus of Questions: Questions will explore participants' perceptions of feedback and its impact on their learning experience.

Data Collection Process: Responses will be analyzed thematically to identify key patterns and insights.

Purpose: This method provides a broader perspective while still capturing rich qualitative data.

4) Observations (Optional)

If applicable, observations of online learning interactions (e.g., discussion forums or feedback sessions) may be conducted.

Focus: Observations will focus on how feedback is delivered and received in real-time online learning environments.

Data Collection Process: Field notes will be taken and analyzed for patterns and themes.

Purpose: This method provides contextual insights into the dynamics of feedback in online learning.

3.4. Data Analysis Methods

3.4.1. Quantitative Data Analysis

1) Descriptive Statistics

Mean, standard deviation, and frequency distributions will be calculated to summarize the survey and experimental data.

2) Inferential Statistics

ANOVA will be used to compare the effects of different feedback types on learning outcomes across the experimental groups.

Regression Analysis will be conducted to examine the relationships between feedback, learning motivation, self-efficacy, and engagement.

3) Software

Statistical analyses will be performed using statistical software.

3.4.2. Qualitative Data Analysis

1) Thematic Analysis

Interview transcripts will be coded and analyzed to identify recurring themes and patterns.

Themes will be organized around key concepts such as the perceived effectiveness of feedback, emotional responses, and suggestions for improvement.

2) Software

Qualitative data will be analyzed using qualitative data analysis software.

3.5. Ethical Considerations

Informed Consent: Participants will be provided with detailed information about the study and their rights before participation.

Confidentiality: All data will be anonymized to protect participants' identities.

Voluntary Participation: Participants can withdraw from the study at any time without penalty.

4. Research Results

This chapter presents the findings of the study, organized according to the research questions and data collection methods. The demographic characteristics of the participants are summarized in Appendix D. Furthermore, the pre- and post-test scores for each experimental group are presented in Appendix E, along with the results of the ANOVA and regression analyses.

4.1. Quantitative Results

4.1.1. Effects of Feedback Types on Learning Motivation

Cognitive Feedback: Participants who received cognitive feedback showed significant improvements in task performance and understanding.

Affective Feedback: This type of feedback was associated with higher levels of emotional engagement and confidence.

Metacognitive Feedback: Participants demonstrated better self-regulation and long-term retention of learning materials.

Control Group: The group that received no feedback showed minimal changes in learning outcomes [4].

4.1.2. Impact of Feedback on Self-Efficacy and Engagement

Self-Efficacy: Participants in the affective and metacognitive feedback groups reported higher levels of self-efficacy compared to the cognitive and control groups.

Engagement: Affective feedback was most effective in increasing students' active participation and interest in the learning task.

4.2. Qualitative Results

4.2.1. Perceptions of Feedback Effectiveness

Participants valued feedback that was specific, timely, and personalized.

Affective feedback was particularly appreciated for its emotional support and encouragement.

4.2.2. Emotional and Behavioral Responses to Feedback

Positive feedback boosted students' confidence and motivation, while negative feedback was perceived as demotivating if not delivered constructively.

Metacognitive feedback helped students reflect on their learning strategies and set goals for improvement [5].

4.2.3. Suggestions for Improving Feedback Practices

Participants recommended incorporating multimedia elements (e.g., audio or video feedback) to make feedback more engaging.

They also emphasized the importance of regular and consistent feedback to maintain motivation.

4.3. Integration of Quantitative and Qualitative Findings

The quantitative and qualitative results complement each other, providing a holistic understanding of the research problem. For example, the quantitative data confirmed that affective and metacognitive feedback were more effective in enhancing self-efficacy and engagement, which aligns with participants' qualitative feedback. The qualitative insights highlighted the importance of emotional support and personalized feedback, which were not fully captured by the quantitative measures [6,7].

5. Discussion

This chapter interprets the findings of the study in the context of existing literature and theoretical frameworks. It also discusses the implications of the results for online education and identifies areas for future research.

5.1. Interpretation of Findings

1) Impact of Feedback Types on Learning Motivation

The study found that affective feedback had the most significant positive impact on students' emotional engagement and self-efficacy. This aligns with Self-Determination Theory, which emphasizes the importance of relatedness and emotional support in fostering intrinsic motivation. Participants described affective feedback as "encouraging" and "motivating," highlighting its role in creating a supportive learning environment.

Cognitive feedback, while effective in improving task performance, was perceived as less impactful on motivation unless paired with emotional or metacognitive elements.

Metacognitive feedback emerged as particularly valuable for promoting self-regulated learning. Participants reported that it helped them "reflect on their learning process" and "set realistic goals," supporting the theoretical link between metacognition and long-term learning outcomes [8].

2) Role of Feedback in Enhancing Self-Efficacy and Engagement

The study confirmed that feedback can significantly enhance students' self-efficacy and engagement, particularly when it is personalized and timely. These findings are consistent with theories of self-efficacy, which posit that positive feedback can strengthen individuals' belief in their ability to succeed.

However, the study also revealed that poorly delivered feedback (e.g., overly critical or generic) can undermine motivation and engagement. This underscores the importance of training educators to provide constructive and supportive feedback.

3) Challenges and Opportunities in Online Feedback Practices

Participants identified several challenges in current feedback practices, including delays in receiving feedback and a lack of personalization. These issues are particularly salient in online environments, where the absence of face-to-face interaction can exacerbate feelings of isolation.

At the same time, participants highlighted opportunities for improving feedback practices, such as incorporating multimedia elements (e.g., video or audio feedback) and providing more frequent and consistent communication [9].

5.2. Theoretical Implications

The study contributes to the literature on feedback and learning motivation by integrating Self-Determination Theory with empirical research on online education. Specifically, it demonstrates how feedback can satisfy students' psychological needs for autonomy, competence, and relatedness, thereby enhancing their motivation and engagement.

Autonomy: Metacognitive feedback was particularly effective in promoting autonomy by encouraging students to take ownership of their learning.

Competence: Affective and cognitive feedback both contributed to students' sense of competence, albeit in different ways.

Relatedness: Affective feedback played a key role in fostering a sense of connection and support, which is especially important in online environments.

These findings extend the applicability of Self-Determination Theory to online education and provide a framework for designing feedback strategies that address students' psychological needs. The thematic analysis of interview transcripts revealed several key themes related to students' perceptions of feedback. A complete list of codes and themes is provided in Appendix D. These findings align with previous research on the role of feedback in online learning environments, as discussed in Appendix F.

5.3. Practical Implications

1) For Educators

Diversify Feedback Formats: Incorporate multimedia elements (e.g., video or audio feedback) to make feedback more engaging and personalized.

Balance Feedback Types: Combine cognitive, affective, and metacognitive feedback to address both task performance and emotional needs.

Provide Timely Feedback: Ensure that feedback is delivered promptly to maintain students' momentum and motivation.

2) For Online Learning Platforms

Develop Feedback Tools: Integrate features that allow educators to provide personalized and multimodal feedback efficiently.

Train Educators: Offer professional development programs to help educators master effective feedback strategies.

3) For Policymakers:

Promote Best Practices: Encourage the adoption of evidence-based feedback practices in online education policies and guidelines.

Support Research: Fund further research on the impact of feedback in diverse online learning contexts.

5.4. Limitations of the Study

1) Sample Limitations

The study focused exclusively on university students, limiting the generalizability of the findings to other populations (e.g., K-12 students or adult learners).

The sample size, while adequate, may not capture the full diversity of experiences in online education.

2) Methodological Limitations

The experimental design, while rigorous, may not fully replicate the complexities of real-world online learning environments.

The reliance on self-reported data (e.g., surveys and interviews) may introduce bias.

3) Contextual Limitations

The study was conducted in a specific cultural and institutional context, which may influence the applicability of the findings to other settings.

5.5. Directions for Future Research

1) Expand the Sample

Future studies should include participants from diverse educational levels (e.g., K-12, vocational training) and cultural backgrounds.

2) Explore Long-Term Effects

Longitudinal studies are needed to examine the sustained impact of feedback on learning outcomes over time.

3) Investigate Technology-Enhanced Feedback

Research could explore the potential of emerging technologies (e.g., AI-driven feedback systems) to enhance feedback practices in online education.

4) Examine Cross-Cultural Differences

Comparative studies could investigate how cultural factors influence the effectiveness of different feedback types.

6. Conclusion and Recommendations

This chapter synthesizes the key findings of the study, discusses their broader implications, and provides actionable recommendations for educators, institutions, and researchers. It also reflects on the study's contributions to the field of online education and identifies avenues for future research.

6.1. Summary of Key Findings

The study investigated the impact of teacher feedback on students' learning motivation, self-efficacy, and engagement in online learning environments. The results revealed that different types of feedback — cognitive, affective, and metacognitive — play distinct yet complementary roles in shaping students' learning experiences.

Affective Feedback was found to be particularly effective in enhancing emotional engagement and self-efficacy. Participants described it as encouraging and motivating, highlighting its role in creating a supportive and connected learning environment.

Metacognitive Feedback emerged as a powerful tool for promoting self-regulated learning. It helped students reflect on their learning strategies, set goals, and improve long-term retention.

Cognitive Feedback, while valuable for improving task performance, was perceived as less impactful on motivation unless paired with emotional or metacognitive elements.

The study also identified challenges in current feedback practices, such as delays in delivery and a lack of personalization, which can hinder the effectiveness of feedback in online settings. Participants suggested that incorporating multimedia elements (e.g., video or audio feedback) and providing more frequent and consistent communication could address these issues.

6.2. Broader Implications

The findings of this study have significant implications for theory, practice, and policy in online education.

1) Theoretical Contributions

The study advances the understanding of feedback mechanisms by integrating Self-Determination Theory with empirical research on online learning. It demonstrates how feedback can satisfy students' psychological needs for autonomy, competence, and relatedness, thereby enhancing their motivation and engagement.

It also highlights the importance of considering both the content and delivery of feedback, particularly in online environments where the lack of face-to-face interaction can amplify the need for emotional and metacognitive support.

2) Practical Implications

For Educators: The findings underscore the importance of adopting a balanced approach to feedback that addresses both cognitive and emotional needs. Educators should strive to provide timely, personalized, and multimodal feedback to maximize its impact.

For Institutions**:** Institutions should invest in training programs and technological tools that enable educators to deliver effective feedback in online settings. They should also prioritize the development of policies that promote best practices in feedback delivery.

For Policymakers: Policymakers can use the findings to advocate for evidence-based approaches to online education, particularly in areas related to teacher training and instructional design.

3) Broader Impact

By improving feedback practices, this study has the potential to enhance the quality and accessibility of online education, making it more effective and inclusive for learners worldwide.

6.3. Recommendations for Future Research

While this study provides valuable insights, it also highlights several areas for further exploration:

1) Expanding the Scope of Research

Future studies should examine the impact of feedback in diverse educational contexts, including K-12 education, vocational training, and professional development programs.

Cross-cultural studies could investigate how cultural factors influence the effectiveness of different feedback types.

2) Exploring Long-Term Effects

Longitudinal research is needed to assess the sustained impact of feedback on learning outcomes over time. This could include tracking students' academic performance, motivation, and engagement across multiple courses or semesters.

3) Leveraging Emerging Technologies

Research could explore the potential of artificial intelligence (AI) and machine learning to enhance feedback practices. For example, AI-driven feedback systems could provide real-time, personalized feedback to students, reducing the burden on educators.

4) Investigating Student Perspectives

Future studies could delve deeper into students' perceptions of feedback, particularly in relation to their individual learning styles and preferences. This could inform the development of more tailored and effective feedback strategies.

6.4. Final Reflections

Feedback is a cornerstone of effective teaching and learning, particularly in online education where the absence of face-to-face interaction can create unique challenges. This study demonstrates that feedback, when designed and delivered effectively, can significantly enhance students' motivation, self-efficacy, and engagement. By integrating theoretical insights with practical recommendations, the study provides a roadmap for educators, institutions, and policymakers to optimize feedback practices in online learning environments.

Ultimately, the goal of feedback is not only to improve academic performance but also to empower students to take ownership of their learning and achieve their full potential. As online education continues to evolve, the insights from this study can help ensure that feedback remains a powerful tool for fostering meaningful and transformative learning experiences.

Appendices

The appendices provide supplementary materials that support the research process and findings. These materials include the survey instruments, interview protocols, and additional data that may be useful for readers who wish to delve deeper into the study.

Appendix A. Experimental Design Details

A.1 Task Description

A detailed description of the online learning task used in the experiment, including instructions, objectives, and assessment criteria.

A.2 Feedback Examples

Examples of the feedback provided to participants in each experimental group:

1) Cognitive Feedback: "Your answer to question 3 is correct, but you could improve your explanation by providing more details."
2) Affective Feedback: "Great effort on this task! Your hard work is paying off, and I'm confident you'll continue to improve."
3) Metacognitive Feedback: "Think about how you approached this task. What strategies worked well, and what could you do differently next time?"

A.3 Pre- and Post-Test Materials

The pre- and post-test questionnaires used to measure changes in learning motivation, self-efficacy, and engagement.

Appendix B. Survey Instruments

B.1 Learning Motivation Scale

This scale was adapted from the Academic Motivation Scale and includes items measuring intrinsic and extrinsic motivation. Example items:

"I enjoy learning new things in this course."

"I participate in this course because I want to achieve high grades."

B.2 Self-Efficacy Scale

Adapted from the General Self-Efficacy Scale, this scale assesses students' confidence in their ability to succeed. Example items:

"I am confident that I can understand the most difficult material in this course."

"I can achieve my learning goals if I put in the effort."

B.3 Learning Engagement Scale

This scale, adapted from the Utrecht Work Engagement Scale, measures students' level of involvement and effort in their learning. Example items:

"I feel energized when I am working on tasks for this course."

"I am fully concentrated when studying for this course."

Appendix C. Interview Protocol and Scale Items

C.1 Interview Questions

The semi-structured interview protocol includes the following questions:

"How did the feedback you received influence your motivation to complete the task?"

"Which type of feedback did you find most helpful, and why?"

"What challenges did you face in understanding or applying the feedback?"

"How did the feedback affect your confidence in your ability to succeed?"

"What suggestions do you have for improving feedback in online courses?"

C.2 Learning Motivation Scale Items

Learning Motivation Scale Items.

Item Number	Item Content	Dimension
1	I enjoy learning new things in this course.	Intrinsic Motivation - Knowledge
2	I study because I want to achieve high grades.	Extrinsic Motivation - External Regulation
3	I feel that learning is meaningless.	Amotivation

Appendix D. Data Analysis Outputs

D.1 Descriptive Statistics Tables

Tables summarizing the demographic data and baseline scores of participants.

D.2 ANOVA and Regression Analysis Output

Statistical outputs from the analysis of variance (ANOVA) and regression analysis, including F-values, p-values, and effect sizes.

D.3 Thematic Analysis Codes

A list of codes and themes identified during the qualitative analysis of interview transcripts.

Appendix E. Ethical Approval Documents

E.1 Institutional Review Board (IRB) Approval Letter

A copy of the IRB approval letter confirming that the study complied with ethical standards.

E.2 Participant Information Sheet

A document provided to participants outlining the study's purpose, procedures, risks, and benefits.

Appendix F. Additional Resources

F.1 Glossary of Key Terms

Definitions of key terms used in the study, such as "cognitive feedback," "affective feedback," and "metacognitive feedback."

F.2 References to Supplementary Literature

A list of additional readings and resources related to feedback, online education, and Self-Determination Theory.

In conclusion, learning motivation plays a key role in students' academic performance. Educators should focus on cultivating students' intrinsic motivation, increasing their interest and engagement in learning, and thereby promoting improvements in academic performance. At the same time, attention should be given to other related factors, such as learning attitudes and emotional management, to comprehensively enhance students' academic outcomes.

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