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Artificial intelligence as a support tool for providing feedback on coursework in higher education: A pilot study

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Abstract

The increasing use of artificial intelligence (AI) in higher education is reshaping feedback practices and raising questions about how AI-generated feedback compares with feedback provided by humans. This pilot study investigates the pedagogical potential of an AI assistant for providing feedback[1] on student´ academic writing in higher education. Drawing on a sociocultural

[1] In this study, feedback is used as an overarching concept encompassing three complementary functions: feed up (clarifying goals and exptectations), feed back (information about current

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perspective on scaffolding and framework distinguishing between feed back and feed forward, the study examines (i) how students experience AI-generated feedback compared with feedback provided by learning assistants, (ii) the extent to which the two feedback sources align with predefined assessment criteria, and (iii) their similarities and differences in the content of the provided feed back and feed forward. Data comprised students´ survey responses and content analysis of feedback provided by the AI assistant and learning assistants on the same type of academic writing assignment. The findings show that both feedback sources largely align with the predefined assessment criteria and provide feedback on students´ current performance as well as feed forward aimed at further development. However, they differ in how this support is enacted. The AI assistant tends to provide more explicit, criteria-focused, and action-oriented guidance, whereas learning assistants provide more contextualized and relationally grounded feedback. Students also expressed a preference for feedback from learning assistants on future assignments. Viewed through a sociocultural lens, these findings suggest that AI-generated and human feedback may represent distinct but complementary forms of pedagogical scaffolding. Rather than replacing human feedback, AI may therefore serve as a pedagogical resource that combines explicit guidance with dialogic and relational support.

Keywords: Academic writing, higher education, AI-generated feedback, feedforward, pedagogical scaffolding, human feedback

Introduction

Academic writing is a core component of higher education, as students are expected not only to acquire disciplinary knowledge but also to develop the ability to critically engage with, interpret, and communicate such knowledge through academic texts (NOU, 2022: 2, 2022). Developing academic writing competence, however, is a demanding process, particularly for students who are still becoming familiar with disciplinary conventions, expectations, and ways of constructing academic arguments (Carless, 2006; Elander et al., 2006; Jonsmoen & Greek, 2012). Students do not develop these competencies in isolation. Feedback from instructors, learning assistants, and peers constitutes an important source of support in the process of learning to write academically (Carless & Boud, 2018; Chalmers et al., 2018; Ruegg, 2015; Sritrakarn, 2018). Yet providing individualized, high-quality feedback is resource-intensive, particularly in higher education contexts characterized by large student cohorts. Recent advances in generative artificial intelligence (AI) have introduced new possibilities for supporting feedback practices at scale (Gentile et al., 2023; Guan et al., 2020; Huang et al., 2021). AI assistants can provide rapid, accessible, and individualized responses to students' texts and are increasingly being explored as tools for supporting teaching, learning, feedback, and assessment in higher education (Gentile et al., 2023; Guan et al., 2020; Holmes & Tuomi, 2022; Huang et al., 2021). These developments raise

performance), and feed forward (guidance for future improvement).

an important pedagogical question: What forms of learning support can AI-generated feedback provide, and how do these compare with those provided by human learning assistants?

Feedback and AI-supported academic writing

Feedback is widely recognized as an important factor in student learning and achievement and is particularly important in academic writing, where students need support in interpreting expectations, evaluating their current performance, and identifying how their texts can be developed further (Hattie & Timperley, 2007). From this perspective, feedback extends beyond correcting errors or evaluating a finished product. It can be understood as "a process through which learners make sense of information from various sources and use it to enhance their work or learning strategies" (Carless & Boud, 2018, p. 1315). Effective feedback therefore involves not only information about current performance but also support that enables students to act on this information and use it to further develop their learning and writing. Feedback on academic writing in higher education has traditionally relied on human feedback providers. Emerging research, however, suggests that generative AI may offer new forms of support for academic writing (Gentile et al., 2023; Guan et al., 2020; Huang et al., 2021). Generative AI assistants, typically based on large language models (LLMs), calculates probability distributions over sequences of words and can therefore be used to analyze and generate natural language text (Vaswani et al., 2017; Zhao et al., 2023) and are increasingly being used to provide feedback on students´ academic writing (Zhang et al., 2026). Research suggests that AI-based tools can provide immediate and accessible feedback and may help students improve aspects of text structure, organization, coherence, grammar, and linguistic precision (Engeness & Mørch, 2016; Guardia-Paniura et al., 2026; Mørch et al., 2017; Urzúa et al. 2025). According to Liu (2024), feedback automated using AI can enhance students´ writing processes and contribute to increased engagement. In their meta-analysis comparing AI-generated and human feedback in educational settings, Kaliisa et al. (2026) found no statistically significant differences in student performance between learners receiving AI-generated feedback and those receiving feedback from human sources. Comparable findings have been reported by Escalante et al. (2023), who found no significant differences between the GPT-4 generated feedback generated using AI and feedback provided by human instructors. Such findings point to the potential of generative AI to supplement existing feedback practices. At the same time, the emerging literature identifies important limitations. Although AI systems may efficiently identify textual features and generate suggestions for revision, human feedback tends to provide greater contextual sensitivity, disciplinary judgement, and actionable guidance (Guardia-Paniura et al., 2026; Tensen et al., 2025). Students may value the accessibility, immediacy, and level of detail provided by AI while simultaneously perceiving AI-generated feedback as less personalized and less sensitive to their individual learning needs than feedback from human sources (Kaliisa et al., 2026). These tensions suggest that the educational value of feedback cannot be assessed solely in terms of efficiency or textual accuracy or effects on student performance. Equally important are the forms of pedagogical and relational support that feedback provides and how this support is experienced by students. Despite the rapidly growing literature on AI-supported learning, less is known about whether AI-generated and human feedback provide comparable forms of pedagogical support when responding to authentic student writing. In particular, two dimensions remain insufficiently understood: first, how AI-

generated and human feedback differ in the pedagogical scaffolding they provide through evaluation of current performance and guidance for further development; and second, whether students experience comparable relational qualities in feedback from the two sources. Moreover, when feedback is intended to support students´ work toward defined academic expectations it is important to examine whether feedback from different sources addresses the assessment criteria communicated to students. Examining these dimensions simultaneously may provide a more comprehensive understanding of the pedagogical possibilities and limitations of AI-generated feedback than comparisons based primarily on writing performance or feedback accuracy.

Feedback as scaffolding

From a sociocultural perspective, learning develops through participation, dialogue, and interaction with others. In Vygotsky´s (1978) theory, support from a more knowledgeable other enables learners to work within their zone of proximal development and accomplish tasks that they may not yet be able to complete independently. Such support is commonly conceptualized as scaffolding (Wood et al., 1976). Applied to academic writing, this framework shifts attention from feedback as an evaluation of a finished product toward feedback as support for an ongoing and learning process and understood as a form of pedagogical scaffolding through which learners are supported in developing disciplinary knowledge and writing competence. Hattie and Timperley´s (2007) feedback model complements this perspective by providing a framework for examining how such support may be communicated through feedback including information about current performance and guidance for subsequent action. Hattie and Timperley (2007) conceptualize effective feedback as information that helps reduce the discrepancy between current and desired performance. Their model distinguishes among three interrelated questions; where am I going (*feed up*), how am I going (*feed back*), and where to next? (*feed forward*) (Hattie & Timperley, 2007, p. 86). Feed up clarifies goals and desired levels of performance, feed back provides information about the learner´s current performance in relation to those goals, and feed forward identifies strategies and actions that may support further progress. Although the model comprises all three dimensions, the present study focuses analytically on feed back and feed forward because feed up was primarily provided through prior teaching and assessment criteria rather than through the feedback texts examined here. Applied to academic writing, this framework shifts attention from feedback as evaluation of a finished product toward feedback as support for an ongoing writing and learning process (Hattie & Timperley, 2007; Price et al., 2010). For students, such support may involve explicit identification of weaknesses in their texts together with concrete suggestions for what can be improved and how (Butler & Winne, 1995). Bringing these theoretical perspectives together allows feedback to be conceptualized as a specific form of pedagogical scaffolding. Vygotsky's sociocultural perspective explains why learners may benefit from support that enables them to move beyond their current level of competence, while Hattie and Timperley's framework provide an analytic means of examining how such support can be enacted through information about current performance, and guidance for subsequent action. This theoretical connection becomes particularly relevant in AI-supported higher education. Traditionally, scaffolding within a sociocultural perspective involves interaction with human actors, such as an instructor, supervisor, learning assistant, or more capable peers. Generative AI introduces a qualitatively different potential source of learning support. Without assuming that AI constitutes a "more knowledgeable other" in the Vygotskian sense, AI-generated feedback may

nevertheless perform some functions associated with pedagogical scaffolding. Both learning assistants and AI chatbots may perform certain functions associated with pedagogical scaffolding by providing information about students´ current performance and guidance for further development. Whether, and in what ways, these functions resemble those provided through feedback from learning assistants remains an empirical question.

The relational dimension of feedback: Human touch

Pedagogical scaffolding represents only one dimension of feedback. Feedback is also embedded in interpersonal and affective processes (de Kleijn et al., 2012; Firing et al., 2013; Värlander, 2008). As Firing et al. (2013, p. 82) argue, "Supervision is a learning process, both academic and personal, that unfolds in the encounter between the student and the feedback provided in text form." From this perspective, feedback involves not only supporting students' academic development but also acknowledging the person engaging in the learning process. Research suggests that feedback is more likely to support subsequent learning when it is experienced as trustworthy, supportive, and responsive to the learner, rather than merely as a technical evaluation of a product (Shute, 2008; von Krogh, 1998; Värlander, 2008). Several studies accordingly emphasize the relational dimension of feedback as an important condition for meaningful learning processes (Dai et al., 2025; Owusu-Agyeman & Moroeroe, 2023; Price et al., 2010; Thompson & Lee, 2012). In the present study, we use the term *human touch* as an analytic concept to capture interpersonal and relational qualities of feedback. Human touch refers to qualities such as personalization, empathy, supportive language, acknowledgement of effort, and sensitivity to students' intentions and needs, while maintaining academic precision. These qualities may be examined both as features of feedback itself and in terms of how they are experienced by students. Rather than treating feedback solely as a technical evaluation of a text, the concept recognizes that feedback is received and interpreted within an interpersonal and affective context. This dimension is particularly relevant when comparing AI-generated and human feedback. Although an AI assistant may produce linguistically supportive and encouraging responses, whether students experience such responses as comparable to the relational support provided by a human learning assistant is an empirical rather than a technological question. The comparison between AI-generated and human feedback therefore concerns both what feedback does academically and how it is experienced relationally. Taken together, the theoretical framework conceptualizes feedback as having two complementary dimensions. The first concerns its pedagogical scaffolding function, examined through feed up, feed back and feed forward. The second concerns its relational dimension, captured through the concept of human touch. These two dimensions provide an analytic basis for comparing AI-generated feedback with feedback provided by learning assistants.

Context and purpose of the present study

The present study was conducted within undergraduate education program at the Norwegian university of Science and Technology (NTNU), specifically in a course on Educational Psychology and Developmental psychology. Lectures, seminars, and structured academic writing activities

form an integrated part of the curriculum. As part of their coursework, students submit a course paper approximately halfway through the semester and receive written feedback from learning assistants. This formative feedback (Haugan & Lysebo, 2015; Parmigiani et al., 2024) is intended to support the development of academic writing competence and students´ preparation for their subsequent summative assessment. This educational context emphasizes active student participation in academic learning communities and dialogue between students and academic staff (NTNU, 2026). Providing individualized feedback to a large student cohort requires considerable resources. Generative AI may offer a supplementary mechanism through which feedback can be provided efficiently and consistently across a large number of student texts. Yet scalability alone does not establish pedagogical equivalence. Before AI-generated feedback can meaningfully complement human feedback practices, it is necessary to understand not only whether AI addresses aspects of students' texts that are relevant to predefined assessment criteria, but also what kind of pedagogical support it provides, how this compares with feedback from learning assistants, and how students experience the relational qualities of feedback from the two sources. The present pilot study addresses this gap by comparing AI-generated feedback with feedback provided by learning assistants on authentic student texts in higher education. Drawing on a sociocultural understanding of learning and Hattie & Timperley´s (2007) feedback model, the study examines pedagogical scaffolding through feed back and feed forward. It further examines the relational dimension of feedback through the concept of human touch. By analyzing these dimensions across AI-generated and human feedback, examining their alignment with predefined assessment criteria, and incorporating students' experiences of the two feedback sources, the study seeks to identify the pedagogical possibilities and limitations of generative AI as a supplementary feedback provider in higher education. The study is guided by the following research questions:

RQ1: How do students experience AI-generated feedback compared with feedback provided by learning assistants, particularly with regard to pedagogical support and human touch?

RQ2: To what extent do AI-generated feedback and feedback provided by learning assistants align with predefined assessment criteria?

RQ3: What similarities and differences characterize the content of AI-generated feedback and feedback provided by learning assistants in terms of feed back, feed forward, and human touch?

Methods

The present study

The empirical basis for this pilot study was drawn from a course in the first year of the one-year and bachelor's programmes in Education at the Department of Education and Lifelong Learning (NTNU), during the autumn semester of 2025. The student population in the course consisted of 360 students. As part of the course requirements, students submitted a compulsory written assignment that had to be approved in order for them to take the final examination. The assignment consisted of producing a 3 to 4 pages course paper. The assignment required students to write a reflective paper on a self-selected topic related to the course themes of self-concept, motivation, and learning. Students could base their discussion on personal experiences or address the topic from a more general perspective, with the goal of relating course concepts to real-life or theoretical examples. The purpose of the assignment was to learn about and practice academic

writing. The course papers were submitted via the institution's digital learning platform, and all students received written feedback on their paper. Under ordinary circumstances, this feedback is provided by learning assistants. However, in the semester under study, students were also offered the opportunity to receive AI-generated feedback on their course paper. Information about the study was provided in lectures and through the course's digital learning platform. Participants were recruited during a scheduled lecture, where students received detailed information about the purpose of the study, what participation would involve, and how their submitted texts would be used if they agreed to participate. A written informed consent was obtained from all students who chose to participate in the study. In total, 23 students consented to participate in the study. The researchers retrieved the submitted papers from the learning platform and anonymized them before they were submitted to the AI assistant. The AI tool generated written feedback on each student paper. The AI-generated feedback was then made available through the learning platform alongside the feedback provided by the learning assistants. When the students received the feedback, it was clearly indicated whether the feedback was provided by AI assistant or by the learning assistant. The survey among the participants was conducted with an online questionnaire that included questions about their perceptions and experiences of AI-generated feedback on their academic texts. The questionnaire was created and administered using Nettskjema, a secure Norwegian web-based survey and data collection tool developed for research and educational purposes. The study was conducted in accordance with current ethical guidelines for research (National Committee for Research Ethics in the Social Sciences and Humanities (NESH), 2023) and was approved by SIKT (Norwegian Agency for Shared Services in Education and Research).

The role of learning assistants in the feedback process: Criteria and structure

The learning assistants were senior students with prior experience from the course. As part of their role, they facilitated course seminars and provided feedback on compulsory assignments submitted by students. The learning assistants were instructed to provide written feedback on the students' papers based on predefined assessment criteria. Their feedback was expected to address the following dimensions: (a) the academic structure of the text, including the cover page with title, table of contents, introduction, theoretical section, discussion, and reference list; (b) the extent to which the student formulated an independent research question; (c) the relevance of the chosen theory in relation to the research question; (d) the degree to which the theory was applied to support the points made in the discussion; and (e) the use of references, including correct application of APA style. The learning assistants were asked to highlight both the strengths of the text and areas with potential for improvement, with particular emphasis on identifying elements that demonstrate disciplinary competence. The following criteria were prioritized in the evaluation process: (i) academic structure, (ii) the text's scope and readability, and (iii) clarification of any disciplinary misunderstandings. All critical remarks were to be formulated in an honest, constructive, and learning-oriented manner.

Artificial Intelligence assistant and its role

An AI assistant was developed to generate feedback for the course papers of the study participants. The AI assistant was made using a prototype web application, which could receive student papers in a structured text format and provide feedback as plain text. The assistant used a

complex system prompt (2270 words long), developed by researchers. The system prompt included a detailed context description, such as the full course content description (without full texts of the syllabus), the purpose of the assignment, expected feedback topics with multiple "IF - THEN" statements, the predefined assessment criteria that were given to the learning assistants, and a full description of the assignment that was given to the students. The AI assistant used GPT 4.o as a foundational LLM. The system prompt included an instruction to limit the generated feedback to 150 words.

The system prompt of the AI assistant was developed iteratively. While in development, it was tested using two papers that were obtained from students who delivered similar course papers in the previous year. The AI assistant was used to generate supplementary feedback on the course papers of students who volunteered to participate in the study.

Data analysis

This study was based on two sources of data: (1) written reflections from 12 students regarding their experiences of receiving feedback from both an AI assistant and learning assistants, as well as their preferences for future feedback practices, and (2) 46 written feedback texts on coursework assignments, including 23 generated by the AI assistant and 23 provided by learning assistants. The use of two complementary datasets enabled an examination of both student perceptions of feedback and the characteristics of feedback produced by different feedback providers. Qualitative content analysis was employed as the overall analytic approach (Berg & Lune, 2012). Following Fauskanger and Mosvold (2014), the analysis combined summative and theory-driven content analysis. The summative focused on identifying patterns in the occurrence of themes and content across the datasets. The theory-driven content analysis drew on Hattie and Timperley's (2007) concepts of feed back and feed forward and on the person-oriented dimension of supervision described by Firing et al. (2013), referred to in the present study as human touch. Following Hsieh and Shannon (2005), these theoretical concepts functioned as predefined analytic categories for examining both academic and relational dimensions of feedback.

Analysis of student perceptions

The student dataset consisted of written reflections collected through three open-ended questions concerning experiences of feedback from the AI assistant, experiences of feedback from the learning assistants, and preferences for future feedback provision. These reflections were elicited through three open-ended questions administered via Nettskjema: *"How did you experience the feedback on your coursework provided by the AI assistant?"*, *"In what ways did feedback from the AI assistant differ from feedback provided by the learning assistant?"*, and *"What type of feedback would you prefer for next year's coursework assignment?"* The analysis was conducted in two stages. First, a summative content analysis was used to identify recurring perceptions and compare how frequently particular viewpoints appeared across student responses. This enabled an overview of common experiences and preferences related to the two feedback sources. Second, a theory-driven content analysis examined how students described the feedback in relation to the concepts of feed back, feed forward (Hattie and Timperley, 2007) and human touch (Firing et al. 2013). Attention was paid to statements describing the informational value of feedback, its potential to support future learning, and the extent to which students

experienced the feedback as personal, supportive, or relational. Thus, this approach follows the principles of theory-driven content analysis described by Hsieh and Shannon (2005), applying an analytical framework that distinguishes between the academic and relational dimensions of feedback.

Analysis of feedback texts

The second dataset consisted of 46 written feedback texts, including 23 generated by the AI assistant and 23 produced by learning assistants in response to the same type of coursework assignment. The analysis was likewise conducted in two stages. First, a summative content analysis examined the scope and content of the feedback, including word counts, sentence counts, and the extent to which comments addressed predefined assessment criteria such as academic structure, research questions, theory, discussion, and references. This analysis also enabled comparison between feedback generated by the AI assistant and the learning assistants. Second, a theory-driven content analysis explored how the feedback reflected the concepts of feed back, feed forward, and human touch. The analysis focused on similarities and differences between the two feedback providers with regard to (a) how students' current performance was evaluated, (b) how future improvement was promoted through feed forward, and (c) how relational and interpersonal aspects were communicated through the feedback.

Feed up as analytical context

Although Hattie and Timperley (2007) describe feed up as an important prerequisite for effective feed back and feed forward (students must first have a clear understanding of "where they are going" before evaluating "where they are" and considering how to progress), feed up was not analyzed as a separate category in this study. Rather, it constituted an important contextual condition. At the beginning of the semester, all students received both oral and written information regarding the purpose, content and assessment criteria of the coursework assignment (feed up). This ensured that students had access to information about expectations and learning goals before receiving feedback.

Results

The analytical categories are presented according to their internal logic. We begin with students' experiences of the two feedback sources as one aim of the study is to explore how AI-generated feedback and feedback from learning assistants are perceived by students. The feedback material from AI assistant and learning assistants is then examined through the dimensions of feed back, feed forward, and human touch. The first two categories capture informational aspects of feedback related to current performance and future improvement, while human touch addresses the relational and interpersonal qualities of feedback.

Students' experiences with receiving feedback from the AI assistant and the learning assistants

To explore students´ experiences of AI-generated feedback, 12 students responded to three open-ended questions addressing (i) their perceptions of feedback received from the AI assistant, (ii) how this feedback differed from that provided by learning assistants, and (iii) their preferences

regarding future feedback practices. Of the respondents, ten were first-year students enrolled in the programme, while two attended the course as an elective or standalone course. The analysis indicates that both the AI assistant and the learning assistants were perceived as valuable sources of feedback. However, the two feedback providers appeared to contribute different qualities, particularly with respect related to specificity, language, trustworthiness, and relational aspects. Seven students described the AI-generated feedback as detailed, comprehensive, and easy to understand. Several respondents highlighted the AI-assistant's ability to identify both strengths and areas for improvement, emphasizing that the feedback was concrete and extensive. As one student noted, *"The AI assistant provides concrete feedback on what was positive and negative in the text," while another commented that "the AI-generated feedback was more detailed and easier to understand*," These responses suggest that the students generally perceived the AI-generated feedback as meaningful, informative, and relevant to their writing process. Furthermore, respondents also said that *"The AI assistant gave surprisingly good feedback and identifies both strengths and areas for improvement,"* and *"The AI assistants provided a longer response and highlighted several potential improvements. That is nice."* At the same time, six respondents identified limitations in the AI assistant feedback. The responses from the AI assistant are by some respondents in this study experienced as general and superficial, and they say for instance: *"Feedback from the AI assistant is fine, but also general,"* and *"The AI assistant feels general and superficial."* Furthermore, the respondents also uttered that *"The AI chatbot uses unnecessarily advanced words."* Respondents also described the feedback as resembling a checklist rather than a dialogue with an engaged reader *"The AI assistant feels a bit 'stiff' in its feedback, as if it is listing criteria that were fed into,"* and *"The AI assistants gives impersonal feedback,"* and *"I'm uncertain whether I can trust feedback from the AI assistant."* Such perceptions may reduce the sense of personal connection to feedback and weaken students' experience of guidance and support. The finding of reservations about relying on the assessment from the AI assistant is noteworthy given that trust has been identified as a central prerequisite for effective feedback processes (Shute, 2008). The results indicate that students may appreciate AI-generated feedback while simultaneously questioning its authority and credibility. In contrast to the AI assistant, feedback from learning assistants is by four students explicitly described as more personal, trustworthy, and contextually relevant. The students explicitly described this by uttering that the learning assistant: "*understands the main points in the text*," "*provides more personal and specific feedback*," "*gives concrete feedback adapted to the academic level of the course*," and by saying that "*feedback from the learning assistant is easy to understand*." Thus, learning assistants' feedback is highlighted as more individualized, better adapted to the specific assignment, and easy to understand. Taken together, these findings suggest that students value different qualities in AI-generated and human feedback. Whereas the AI assistant was primarily appreciated for its detailed and comprehensive comments, learning assistants were valued for providing feedback perceived as credible, relationally supporting, and tailored to the student's text. The latter qualities may contribute to a stronger sense of safety and trust in the feedback process. As previous research suggested, feedback that combines academic guidance with relation and emotional support can strengthen both students' academic development and their sense of self-efficacy (Firing et al., 2013). Although feedback from both sources was generally appreciated, 11 of the 12 students who responded to the question about future feedback indicated that they primarily preferred feedback from a learning assistant on future assignments.

Similarities and Differences in Feedback from AI assistant and Learning Assistants

The following section addresses two research questions: (i) how closely AI-generated feedback and feedback provided by learning assistants correspond to the predefined assessment criteria, and (ii) what similarities and differences exist between the two feedback sources, particularly regarding feed back, feed forward, and the interpersonal dimension referred to as human touch. The scope and structural characteristics of feedback generated by the AI assistant and feedback provided by the learning assistants are presented in Table 1 and Table 2.

Table 1.

Number of words in feedback generated by the AI assistant and provided by the learning assistants.

Student text	AI assistant	Learning assistants	Word count difference
1.	274	145	129
2.	165	94	71
3.	183	220	37
4.	181	84	97
5.	221	73	148
6.	207	97	110
7.	178	235	57
8.	213	96	117
9.	255	243	12
10.	314	218	96
11.	209	85	124
12.	223	105	118
13.	203	87	116
14.	247	183	64
15.	191	123	68
16.	222	193	29
17.	174	90	84
18.	242	105	137
19.	180	92	88
20.	230	124	106
21.	241	177	64
22.	174	76	98
23.	280	314	34

The results of the quantitative content analysis show substantial variation in the length of the feedback provided to students, ranging from 73 words to 314 words. In 20 of the 23 cases, the AI assistant produced the longest feedback, whereas the learning assistants provided the most extensive feedback for only three students. These differences indicate a lack of consistency in the scope of feedback, which may influence students' perceptions of quality and their learning outcomes. Although longer feedback may offer more detailed guidance and potentially support students' learning processes, length alone does not guarantee higher quality. Research suggests that effective feedback is determined not by quantity but by relevance, specificity, and its forward-looking orientation (Hattie & Timperley, 2007). Consequently, variation in word count should be interpreted with caution and considered in relation to the pedagogical value of the feedback content. In this study, the AI assistant was instructed to produce feedback of approximately 150 words, whereas the learning assistants were not given any guidelines regarding length. This likely accounts for part of the variation and underscores the importance of clear guidelines for both the scope and content of feedback, regardless of who provides it.

Feedback on structure and content

Table 2.

Number of responses from the AI assistant and the learning assistants across assessment dimensions.

	Yes, explicit	Yes, Implicit	Not at all
Academic structure			
AI assistant	17	6	
Learning assistants	9	12	2
Research question			
AI assistant	22		1
Learning assistants	17	1	5
Theory			
AI assistant	23		
Learning assistants	21	2	
Discussion			
AI assistant	23		
Learning assistants	20	2	1
References			
AI assistant	23		
Learning assistants	22		1

Both the AI assistant and the learning assistants provided feedback on academic structure, indicating that this was a shared area of focus. However, the AI assistant addressed academic structure more consistently than the learning assistants. The chatbot commented on structure in

all submissions, providing explicit feedback in 17 cases and more indirect comments in the remaining six. Examples include statements such as: *"The structure of the text follows academic expectations, with a clear division into introduction, theory section, discussion, and references," "Let me acknowledge the well-structured layout."* Similarly, the learning assistants also evaluated academic structure, but they did so less frequently and often in a less explicit manner. Explicit comments on structure were identified in nine submissions, for example: *"The assignment is well structured, with a clear division into introduction, theory, discussion, conclusion, and references."* In an additional 12 evaluations, comments on structure were more indirect, and required a holistic reading to determine whether the student has met expectations regarding academic organization, as reflected in statements such as: *"Your assignment demonstrates a very clear and coherent line of argument from introduction to conclusion."* Taken together, the findings suggest that both sources of feedback emphasized academic structure, but the AI chatbot did so more systematically and explicitly, whereas the learning assistants were more likely to communicate their evaluation of structure indirectly through comments on coherence and argumentation. Both the AI assistant and the learning assistants frequently commented on the students' research questions, suggesting that this was an important assessment criterion for both sources of feedback. However, the AI assistant addressed the research question more consistently, commenting on it in 22 of the feedback instances compared with 17 among the learning assistants. Moreover, the AI's feedback was consistently explicit, taking a clear position on both the quality of the research question and the extent to which it was addressed throughout the text. This is illustrated by statements such as: *"The research question presented in the introduction is well formulated, and you discuss it throughout the text,"* and *"Your research question is clearly articulated, and you address all aspects of it in your discussion."* The learning assistants also paid considerable attention to the research question, but their feedback displayed greater variation. In many cases, they provided direct evaluations, such as: *"You have formulated a well-developed research question."* However, unlike the chatbot, the learning assistants were more likely to identify omissions of areas for improvement. This is reflected in comments such as: *"Next time you write an academic text, I recommend that you also formulate a research question."* Overall, the findings indicate both similarities and differences. Both the AI assistant and the learning assistants regarded the research question as a central element of academic writing. However, whereas the chatbot predominantly provided affirmative and standardized evaluations, the learning assistants offered more varied feedback that included both positive evaluations and constructive criticism. The AI assistant and the learning assistants addressed theory in all evaluations. Indicating that theoretical understanding was a central focus in both sources of feedback. In both cases, feedback was predominantly explicit and concerned to the relevance of the selected theories and the extent to which theory was integrated into the text. The AI assistant consistently provided direct evaluations of students' theoretical choices and their application of theory. This is illustrated by statements such as: *"Your choice of theory is relevant,"* and *"The theoretical section is well formulated, drawing on relevant theory from educational psychology, and the theories you have selected are appropriate for your analysis."* Similarly, the learning assistants provided explicit feedback on students' use of theory in most evaluations. Examples include comments such as: *"You have made a good choice by focusing primarily on one theory in depth, this is excellent and demonstrates a solid disciplinary understanding,"* and *"The theory you have chosen to illuminate the topic is highly relevant, and you make an interesting connection to the statistics you have included."* However, unlike the chatbot, which provided explicit comments in all cases, the learning assistants

addressed the theoretical dimension more indirectly in two evaluations. Overall, the findings suggest substantial similarities between the AI assistant and the learning assistants. Both consistently emphasized the relevance of theoretical perspectives and their integration into the text. The primary difference concerns the consistency and depth of the feedback. Whereas the chatbot provided explicit evaluations in every case, the learning assistants conveyed their assessment of theory directly in 21 of the 23 cases and frequently elaborated more specifically on the strengths of the students' theoretical reasoning. Both the AI assistant and the learning assistants paid considerable attention to the discussion section, indicating that this was a central aspect of the feedback provided by both sources. In both cases, the feedback focused on the quality of students' reflections and their ability to connect theoretical concepts with practical examples. The AI assistant commented on the discussion section in all feedback instances. This is reflected in statements such as: "Your discussion is engaging and uses theoretical principles to illuminate practical examples," and "Your discussion is well grounded in theory and supported by illustrative examples." Similarly, the learning assistants addressed the discussion in 22 of their 23 feedback comments. Their evaluation frequently emphasized the quality of students' reflections and the integration of theory and practice, as illustrated in comments such as: "Your discussion section contains strong reflections linked to the theory you have presented, very well done," and "You engage in a thoughtful discussion and successfully connect theory to practice in a convincing manner." Overall, the findings suggest a high degree of similarity between the AI assistant and the learning assistants in their evaluation of the discussion section. Both highlighted the importance of linking theory to practice and recognized strong reflective reasoning. The main difference concerns the consistency of the feedback, whereas the chatbot commented on the discussion section in every case, the learning assistants did so in 22 of the 23 evaluations. Both the AI assistant and the learning assistants commented extensively on the use of references, indicating that referencing was regarded as an important component of academic writing by both sources of feedback. However, the chatbot addressed reference use in all evaluations, whereas the learning assistants did so in 22 of the 23 evaluations. The Ai assistant's feedback was consistently explicit and typically covered both the extent of reference use and adherence to APA style conventions. This is illustrated through comments such as: *"You have used several references, which is good. It is important to follow APA style and make sure that all references are correctly listed in your reference list,"* and *"The references are in accordance with APA style, which enhances the academic quality of your assignment."* Similarly, the learning assistants frequently commented on students' use of references. However, their feedback tended to focus more narrowly on formatting issues and the technical execution of citations. This is reflected in remarks such as: *"Your referencing is correct,"* and *"The reference list should not be formatted as a bullet-point list."* Overall, the findings reveal both similarities and differences in how the AI chatbot and the learning assistants addressed references. Both emphasized the importance of correct referencing and adherence to academic standards. However, whereas the chatbot typically combined comments on reference quantity, quality, and APA compliance, the learning assistants focused more specifically on the technical accuracy and formatting of citations and reference lists.

Feed back, feed forward, and human touch

In accordance with Hattie and Timperley's (2007) model, effective feedback comprises three core informational components: clarification of goals (feed up), information about current performance levels (feed back), and guidance for further development (feed forward). Together, these elements

help students understand what is expected of them, where they currently stand in relation to these expectations, and how they can reduce the gap between their present and desired performance. In this study, feed up is treated as a didactic precondition, while the analysis focuses on the content of the feedback, with particular emphasis on feed back, feed forward, and the relational dimension referred to here as human touch.

Table 3.

Frequencies of feed back, feed forward, and human touch sentences in feedback from the AI assistant and the learning assistants.

Frequency	Total number of sentences	Lowest number of sentences	Highest number of sentences
Feed back			
AI asssistant	168	4	10
Learning assistants	140	3	11
Feed forward			
AI assistant	106	2	9
Learning assistants	55	0	7
Human touch			
AI assistant	60	1	5
Learning assistants	73	1	7

Feed back

Both the AI assistant and the learning assistants primarily provided feed back that informed students about the extent to which their texts met key academic criteria. Thus, a central similarity between the two feedback sources was their focus on evaluating students' current performance in relation to academic goals and expectations. In both cases, feed back addressed core elements of academic writing, including structure, use of theory, academic language, and referencing. Despite this shared focus, notable differences emerged in the nature of the feedback. The AI-generated feedback had a distinctively evaluative character and placed strong emphasis on formal quality and alignment with established academic standards. This is reflected in statements such as: *"Your assignment has a good structure and a clear organization into introduction, theory, discussion, and references," "You have submitted a well-developed paper that demonstrates a clear understanding of central theories in educational psychology,"* and *"Your references follow APA style, and it is positive that you have included more than five sources."* The learning assistants also evaluated students' performance against academic criteria, but their feedback was generally more nuanced and elaborative. Compared with the AI assistant, they more frequently highlighted academic precision, linguistic quality, and the students' ability to connect theory to practice. Examples include: *"You maintain a consistently good and clear academic language, in addition to providing a*

well-structured paper," "It is beneficial that your introduction situates the research question in context, allowing the reader to understand what the text aims to address," "You have written a solid, academically sound, and well-organized text with a good balance between theory, discussion, and conclusion," and *"The theories are used precisely and appropriately, and you link them well to your own experiences."* Taken together, the findings suggest that both the AI chatbot and the learning assistants primarily provided feedback about students' current level of performance, corresponding closely to the feedback dimension in Hattie and Timperley's model. However, whereas the chatbot tended to provide more standardized evaluations focused on compliance with academic criteria, the learning assistants more often offered contextualized comments that emphasized disciplinary understanding, language quality, and the application of theory. These similarities and differences provide an important basis for examining the extent to which the two feedback sources also support students' future learning. The following section therefore presents findings related to feed forward, with particular emphasis on how the feedback offers concrete advice and strategies for further development of the students' academic writing.

Feed forward

Feed forward points toward future improvement and indicate what *students* can do to reach a higher academic standard in their writing. Both the AI assistant and the learning assistants provided feed forward aimed at supporting students' further development. A clear similarity between the two feedback sources was their focus on helping students improve central aspects of academic writing, including the formulation of research questions, the use of theory, referencing practices, and the overall structure and coherence of the text. The AI assistant frequently offered suggestions framed in relation to academic criteria and writing conventions. Examples include: *"The assignment could benefit from further specifying the research question in the introduction, preferably by using interrogative wording," "Ensure that you consistently apply theory in the discussion to support your arguments," "For future assignments, you might consider expanding some of your discussions with additional practical examples or case studies to further strengthen your arguments," "Consider integrating more sources in your reference list to reinforce the academic foundation of your text,"* and *"It would be beneficial to work on the flow of the text so that the connections between paragraphs become stronger."* Similarly, the learning assistants provided advice aimed at further improvement. Examples include: *"A clear research question could give your paper an even more explicit direction," "Remember to cite sources throughout the text, including in the discussion," "To strengthen the text further, you could use more transitional words ('in addition,' 'therefore,' 'on the other hand') to link the paragraphs more effectively," "To elevate the assignment further, you could engage in a more critical discussion, connect the theory more closely to your own experiences, and tighten some paragraphs to improve coherence,"* and *"For even better balance, the discussion section could be somewhat more extensive."* Although the content of the feed forward was largely similar across the two feedback sources, some differences were identified. Both emphasized clearer research questions, stronger use of theory, improved referencing, and greater coherence in the text. However, suggestions from the AI assistant tended to be formulated as generalized recommendations linked to academic standards, whereas the learning assistants more often provided context sensitive and pedagogically oriented advice tailored to the specific strengths and weaknesses of individual texts. Across both feedback sources, feed forward primarily targeted (i) a clearer articulation of the research question, (ii)

deeper critical engagement with theory and increased use of sources, and (iii) stronger structure and coherence. Taken together, the findings suggest that both the AI chatbot and the learning assistants sought to support future learning by identifying concrete opportunities for improvement. However, whereas the AI assistant primarily communicated these opportunities through standardized recommendations related to academic criteria, the learning assistants more frequently contextualized their suggestions within the students' specific texts and lines of argumentation. An additional important question concerns what characterized the human response beyond structural and disciplinary advice. The following section therefore turns to the human dimension of feedback.

Human touch

In this study, human touch refers to communicative elements that make feedback personal and relational, including expressions of empathy, care, encouragement, and personalized adaptation that create a sense of human presence within an academic context (Dai et al., 2025; Owusu-Agyeman & Moroeroe, 2023; Värlander, 2008). The analysis shows that both the AI assistant and the learning assistants express elements of human touch through recognition, encouragement, and relational language. In both cases, feedback extends beyond technical evaluation and includes communicative features intended to acknowledge students' efforts and support their academic development. Thus, a notable similarity between the two feedback sources is their attempt to create a positive and encouraging feedback experience. Despite this shared orientation, clear differences emerge in the ways human touch is communicated. The AI assistant primarily expresses recognition through formal acknowledgements and standardized encouragement. Examples include: *"Best of luck moving forward, and good work so far," "Thank you for your effort in submitting a thorough text,"* and *"Thank you for sharing your work with me."* While these statements communicate appreciation and support, they do so through relatively neutral and professional language. The feedback emphasizes effort, structure, and work processes, resulting in a form of encouragement that appears supportive but emotionally restrained. By contrast, the learning assistants express human touch through a more personal and relationally oriented communication style. They employ varied language, direct address, informal expressions, and emotional markers such as emojis. Examples include: *"Bravo!" "Very well delivered and great job* 😊*," "I love the metaphors you incorporate," "It has been exciting to contribute throughout your assignment," "With practice, you'll get there* 😊*,"* and *"You make it very pleasant for me as a reader to follow your reasoning throughout the entire assignment." Their feedback not only recognizes performance but also communicates personal engagement with the student's text and development process.* Taken together, the findings indicate that both the AI assistant and the learning assistants incorporate elements of human touch into their feedback. However, the nature of this human touch differs. Whereas the chatbots tends to provide standardized and professionally framed expressions of encouragement, the learning assistants communicate a more personalized, emotionally expressive, and relational form of support. The distinction therefore appears not to lie in whether human touch is present, but in the degree of emotional resonance, personal involvement, and relational closeness conveyed through the feedback.

Discussion

This study examined the potential of an AI assistant as a pedagogical support tool for providing feedback on written coursework in higher education. The findings show that students perceived both the AI assistant and the learning assistants as valuable sources of feedback. However, the two feedback sources appeared to offer different qualities, particularly in terms of specificity, language, trustworthiness, and relational aspects. Taken together, these findings suggest that students value different qualities in AI-generated and human feedback. In line with previous research (Guardia-Paniura et al., 2026; Tensen et al., 2025), the AI assistant was primarily valued for its detailed and comprehensive comments, whereas the learning assistants were valued for providing feedback perceived as more relational, supportive and tailored to the individual student's text. Furthermore, the analysis, of the feedback provided by the AI assistant and the learning assistants revealed both convergences and divergences between the two sources. These patterns can be understood through Vygotsky's sociocultural theory of learning and Hattie & Timperley's model of feedback. The concept of human touch was additionally employed as an analytic lens to explore the relational dimension of feedback.

The length of feedback

The results show substantial variation in feedback length. In 20 of the 23 cases, the AI assistant provided the longest feedback. A similar pattern has been reported in previous research, with AI-generated feedback being more extensive than human feedback (Guo & Wang, 2024). However, the differences observed in the present study should be interpreted with some caution as the AI assistant was instructed to provide responses of approximately 150 words, whereas the learning assistants were not given comparable guidelines regarding feedback length. The difference may therefore partly reflect the conditions under which the feedback was provided. From a pedagogical perspective, more extensive feedback may be beneficial by providing students with detailed information about several aspects of their work and offering multiple suggestions for improvement. At the same time, a greater amount of feedback is not necessarily more useful. Extensive feedback may place greater demands on students to identify, interpret, and prioritize the information that is most relevant for further development. Thus, feedback length alone cannot be regarded as an indicator of quality. Rather, the pedagogical value of feedback depends on whether information provided is relevant, comprehensive, and actionable for students. The amount of feedback should therefore be considered in relation to its pedagogical usefulness rather than as an indication of quality in itself.

Scaffolding through feed back and feed forward: Comparing AI and learning assistants

The findings indicate substantial similarities between the AI assistant and the learning assistants in the aspects of academic writing they addressed. Both sources provided comments related to the predefined assessment criteria, including problem formulation, theoretical grounding, discussion, and referencing. This suggests that the assessment criteria provided a shared framework for identifying strengths and areas for improvement in students' texts. At the same time, differences emerged in how the two sources communicated and contextualized their feedback. The AI

assistant addressed the criteria more consistently and explicitly, particularly in relation to structure and problem formulation, whereas the learning assistants' comments were more varied and more closely contextualized within the individual student's text and line of argumentation. Thus, the main distinction was not necessarily what the two sources addressed, but how their guidance was formulated and adapted to the students. These findings can be interpreted through Vygotsky's (1978) sociocultural perspective on learning and the concept of scaffolding (Wood et al., 1976). From this perspective, support is pedagogically meaningful when it helps learners move beyond what they can currently accomplish independently. Both the AI assistant and the learning assistants can be understood as providing forms of scaffolding, although the nature of this support differed. The AI assistant provided systematic support by consistently identifying aspects of the texts that did not fully meet academic criteria and by suggesting areas for improvement. This may be particularly useful for students who need explicit guidance regarding academic conventions and expectations. The learning assistants, by contrast, appeared to provide more contextualized scaffolding by relating their suggestions more closely to the individual text and the student's line of reasoning. The findings therefore suggest that AI-generated and human feedback may provide different, and potentially complementary, forms of pedagogical support. These differences can be further understood through Hattie and Timperley's (2007) distinction between feed up ("Where am I going?"), feed back ("How am I going?"), and feed forward ("Where to next?"). In the present study, feed up was primarily established through the course syllabus, assignment instructions, and assessment criteria. The analysis therefore focused on feed back and feed forward. Both the AI assistant and the learning assistants provided information about student's current performance in relation to the assessment criteria, corresponding to the feedback function in Hattie and Timperley's model (2007). Importantly, both sources also moved beyond identifying current strengths and weaknesses by suggesting how the students could further develop their texts. The findings suggest that both AI assistants and learning assistants provided feedback about students' current level of performance, corresponding closely to the feedback dimension in Hattie and Timperley's model (2007) claiming that effective feedback must provide information about the learner's current performance in relation to goals. The clearest difference emerged in how feed forward was provided. AI assistant produced feed forward comments more frequently and consistently and tended to formulate recommendations explicitly in relation to predefined academic criteria. The learning assistant provided fewer and more varied feed forward comments, but their suggestions were more frequently contextualized within the specific text and the student's argumentation. This distinction is pedagogically important because the presence of feed forward alone does not determine its value; how suggestions for further development are formulated and connected to the learner's current work may influence their usefulness. Thus, the findings extend the distiction between feed back and feed forward by showing that different feedback sources may fulfil the same broad feedback functions while doing so in qualitatively different ways. The consistency and explicitness of the AI assistant's feed forward may offer particular advantages by making possible nexts steps visible to students. This aligns with previous research emphasizing the importance of constructive comprehensible feed forward for subsequent learning (Falchikov, 2005; Price et al., 2010; Sadler et al., 2023; Topping, 1998). At the same time, more frequent or explicit feed forward should not automatically be interpreted as more effective feed forward. The learning assistants' more contextualized suggestions may provide pedagogical value by directing attention to the particular argument, theoretical reasoning, or issue that the individual student needs to develop. The findings therefore point towards a

distinction between consistency and contextualization: AI-generated feedback may offer systematic and explicit guidance assessment criteria, whereas human feedback may offer more situated guidance responsive to the particular text. Rather than indicating that one source provides superior scaffolding, the findings suggest that the two sources may support students' further development in different ways. Both the AI assistants and the learning assistants can be understood as providing forms of scaffolding, although the nature of this support differed. This interpretation is also supported by the students' perceptions of the two feedback sources. Both the AI assistant and the learning assistants were perceived as valuable sources of feedback. While students valued the detailed and explicit nature of the AI-generated feedback, some perceived it as somewhat rigid, whereas feedback from the learning assistants was more often experienced as personalized. This suggests that differences identified in the textual analysis were also reflected in how students experienced the feedback they received.

Relational scaffolding and the human touch

The most prominent difference between the AI assistant and the learning assistants concerned the relational quality of the feedback, referred to in this study as human touch. Although the AI assistant frequently employed polite, appreciative, and affirming formulations, these responses often appeared standardized and professionally distanced. In contrast, the learning assistants' feedback was characterized by greater personal engagement, emotional resonance, and relational closeness. Students similarly described feedback from the learning assistants as more personalized, trustworthy, and responsive to their individual work. Thus, while the AI assistant primarily provided structured, criteria-oriented support, the learning assistants more clearly combined academic guidance with relational attunement. This finding extends the discussion beyond the informational function of feedback. Previous research has emphasized that feedback is also a relational process in which recognition, trust, positive emotions, and psychological safety can influence whether and how students engage with the feedback they receive (Dai et al., 2025; Firing et al., 2013; Owusu-Agyeman & Moroeroe, 2023; Värlander, 2008). From this perspective, the learning assistants' use of a personal tone, direct address, and emotional markers may represent more than a stylistic difference. Comments such as "*Very well delivered and a great job*..." and "*I love the metaphors you incorporate...*" Explicitely acknowledge the student and their work. By comparison, the AI assistant more frequently used generic affirmations, such as "*Thank you for your effort in submitting a thorough text*..." and "*Thank you for sharing your work with me*." Although courteous and supportive in tone, such formulations were less closely connected to the student's specific intentions or individual learning process. Human touch can therefore be understood as encompassing personalization, emotional responsiveness, recognition of effort, and a sense of being seen and acknowledged as a learner (de Kleijn et al., 2012; Firing et al., 2013; Värlander, 2008). From a sociocultural perspective, this relational dimension can be understood as an integral component of pedagogical scaffolding. This interpretation is supported by studies showing that relationships and trust-based dialogue are key conditions for student engagement in feedback processes (Price et al., 2010; Shute, 2008; von Krogh, 1998; Värlander, 2010). If learning develops through socially mediated interaction, scaffolding involves more than the transmission of information about what is correct, incorrect, or in need of improvement. It also involves responsive support attuned to the learner's current understanding, emerging competence, and participation in the learning process. From this perspective, the learning assistants may function

not only as more knowledgeable to others, but as relationally responsive more knowledgeable others, combining academic guidance with recognition, encouragement, and contextual sensitivity. The human touch identified in their feedback may therefore be interpreted as a form of a relational scaffolding, complementing the cognitive and academic scaffolding traditionally associated with feedback. The students' responses support this interpretation. Although the AI assistant was generally perceived as a valuable source of feedback, some students characterized its responses as general or superficial, unnecessarily complex in language, and less trustworthy. Four students explicitly described feedback from the learning assistants as more personal, trustworthy, and warm. Moreover, 11 of the 12 students who responded to the questions about future feedback indicated that they would primarily prefer feedback from a learning assistant on future assignments. This preference does not necessarily suggest that AI-generated feedback was perceived academically inadequately. Rather, it may indicate that students distinguish between the informational usefulness of feedback and the relational conditions under which feedback becomes personally meaningful, credible, and actionable. This interpretation is consistent with research emphasizing the role of dialogue, trust, and emotional safety in students' engagement with feedback (Firing et al., 2013; Price et al., 2010; Värlander, 2010). Accordingly, the distinction between AI-generated and human feedback may not be adequately captured by asking which source provides "better" feedback. A more pedagogically relevant question is what forms of scaffolding each source is capable of providing. In the present study, the AI assistant demonstrated considerable capacity for structured, criteria-oriented, and action-directed scaffolding, whereas the learning assistants contributed more strongly to contextualized and relational scaffolding. These functions may be complementary rather than competing. From this perspective, the pedagogical potential of AI may lie not in replacing human feedback, but in complementing feedback practices while preserving the relational dimensions that students appear to value. This interpretation should, however, be approached with some caution. In the present study, students knew whether the feedback was generated by the AI assistant or provided by a learning assistant. Their evaluations may therefore have been influenced not only by characteristics of the feedback itself, but also by their perceptions and expectations of its source. Previous research suggests that knowledge about whether feedback is AI- or human-generated can influence how feedback is evaluated (Nazaretsky et al., 2026). Consequently, students´ evaluations in the present study cannot be attributed solely to differences in the content and characteristics of the feedback itself. As mentioned, pre-existing expectations, assumptions, or attitudes towards AI and human feedback providers may also have shaped their responses. Future research should therefore examine relational scaffolding under conditions in which students are blinded to the feedback source or the source is systematically manipulated, making it possible to distinguish more clearly between the relational qualities embedded in the feedback and students´ pre-existing perceptions of AI and human feedback.

Replacing or complementing human feedback? The role of AI assistants in academic writing

Overall, the findings of this study indicate that both AI and learning assistants provide feedback that is largely grounded in predefined assessment criteria. This suggests that AI-generated feedback, like human feedback, has potential to support students' academic writing in higher education. However, the findings also point to the important differences between the two

feedback sources, suggesting that the potential of AI lies primarily in complementing rather than replacing human feedback. AI offers several potential advantages. It can provide feedback quickly and consistently across large volumes of submissions and generate action-oriented suggestions that may support students in revising their texts. Moreover, AI is not affected by factors such as fatique or fluctating attention that may influence human feedback. Used strategically, AI-generated feedback may also free up time for learning assistants to engage in pedagogically feedback, such as one-to-one guidance and small-group academic discussions, where disciplinary depth, dialogue, and relational quality can be developed. These advantages, however, depend on the quality of the parameters and instructions guiding the AI system. At the same time, the findings highlight several limitations of AI-based feedback. One concerns the accuracy, relevance, and specificity of the information generated by the chatbot. In this study, some AI-generated feedback appeared overly general, which may partly reflect limitations in the predefined directives provided to the system. The quality of AI-generated feedback is therefore closely related to the quality and specificity of human guidance underlying its use. Although AI systems may appear autonomous (UNICEF, 2021), they remain dependent on human decisions regarding assessment criteria, prompts, and pedagogical purposes. Consequently, AI-generated feedback should not be regarded as inherently authoritative, or unequivocal as insufficiently specific or inaccurate feedback may create uncertainty and potentially undermine students' trust in the feedback process. A further limitation concern the relational dimension of feedback. Although the AI assistant was able to generate affirming and supportive language, its responses sometimes lacked the relational grounding evident in feedback from learning assistants. Feedback that appears linguistically rigid, overly formal, or insufficiently attuned to the individual student may reduce students' engagement with the feedback. This is particularly important because students value feedback that is comprehensible, relevant, and useful for further learning (Falchikov, 2005; Topping, 1998). Thus, the educational value of feedback cannot be understood solely in terms of the information it provides. It also depends on how feedback is communicated and situated within the broader pedagogical relationship. From a sociocultural perspective, this distinction is particularly important, as effective scaffolding involves not only providing task-relevant information but also adapting support to the learner's needs within an interactive and relational process. Taken together, the findings suggest a complementary division of roles between AI and human feedback. The AI assistant may provide rapid, criteria-based, and action-oriented feedback and, to some extent, interpersonal support through affirming language. Learning assistants, however, appear to have a particularly important role in providing academically contextualised, personalised, and trust-based guidance. Rather than asking whether AI can replace human feedback, the more relevant pedagogical question may therefore be how AI-generated and human feedback can be combined in ways that enhance students' learning and academic writing. Delegating feedback on academic texts entirely to AI, without careful consideration of pedagogical purposes, learning objectives, and the relational dimensions of supervision, therefore appears premature. AI may serve as a valuable supplement to human feedback, but the present findings do not support its use as a replacement for human expertise and interaction. The interpretation is further supported by the students´ preferences. Of the 12 students participating in the study, 11 reported that they would prefer to receive feedback primarily from a learning assistant on future assignments. Although this finding should be interpreted cautiously given the small sample, it indicates that students continue to place substantial value on the human and relational dimensions of feedback, even when AI can provide relevant and academically useful responses.

Practical Implications

Overall, the findings suggest that AI can serve as a useful supplement for academic writing, supporting previous research indicating that AI-generated feedback may complement feedback provided by educators (Tensen et al., 2025). In practice, AI could function as a first-line feedback tool, providing, students with initial, criteria-based feed back and feed forward, while learning assistants could provide more individualized guidance, clarify and elaborate on the feedback through dialogue, and attend to the relational dimensions of the feedback process. Such a division of roles may allow the complementary strengths of AI and human feedback to be used more effectively. The findings also point to the importance of establishing clear guidelines for AI-supported feedback practices. Shared minimum requirements concerning the scope, specificity, relevance, and forward orientation of feedback may contribute to greater consistency and quality. At the same time, AI-generated feedback depends on clearly defined assessment criteria and carefully formulated instructions. Educators should therefore not only consider whether AI is used, but also how it is configured and integrated into pedagogical practices and learning objectives. AI-generated feedback may also provide a useful starting point for subsequent dialogue about students' academic writing. For example, initial AI-generated feed back and feed forward could be discussed in seminars, small groups, or individual supervision, enabling students to critically examine both the feedback itself and how it can be used to revise their texts. Such activities may facilitate meta-dialogues in which attention shifts from the specific qualities of an individual text towards broader understandings of assessment, feedback, and strategies for improvement (Carless & Bound, 2018). In this way, AI-supported feedback may create opportunities for learning assistants to devote more attention to dialogical and relational forms of scaffolding, helping students to understand, evaluate, and act upon feedback rather than primarily producing feedback comments. At the same time, the findings underscore the continued importance of the relational competence of learning assistants. Communication, recognition, empathy, and care may contribute to students´ sense of being supported and recognized as individual learners. Professional development for learning assistants should therefore address not only disciplinary knowledge and an assessment competence, but also the relational and communicative dimensions of feedback. From this perspective, AI should not be understood as a substitute for human interaction, but as a resource that may enable learning assistants to focus more strongly on those aspects of feedback that depend on dialogue, contextual understanding, and relational sensitivity. Taken together, these practical implications suggest that the key question is not simply whether AI should be used to provide feedback, but how AI-generated and human feedback can be pedagogically orchestrated to support students´ learning. This requires clear guidelines for AI use, attention to the quality and purpose of AI-generated feedback, and deliberate integration of human dialogue and relational support into the feedback process.

Limitations of the study

The study has several methodological limitations related to its sample, context, and design. First, the participants were first-year students in Education, many of whom were engaging with academic writing in higher education for the first time. Their experience and response to feedback may therefore differ from those of students at more advanced levels of study or with greater experience in academic writing. Moreover, this pilot study included a relatively small number of

participants, and only 12 students responded to the questions concerning their experience of receiving feedback from the AI assistant and the learning assistants. The findings concerning students' perceptions and preferences should therefore be intepreted with caution and cannot be assumed to represent the experiences of a broader student population. A further limitation concern the transparency of the feedback source. Students knew whether the feedback was generated by the AI assistant or provided by a human learning assistant, which may have influenced how they perceived and evaluated the feedback. Consequently, students´ evaluations in the present study cannot be attributed solely to differences in the content and characteristics of the feedback itself. As mentioned, pre-existing expectations, assumptions, or attitudes towards AI and human feedback providers may also have shaped their responses (Nazaretsky et al., 2026). Future studies could address this limitation by using blinded or partially blinded designs to examine whether perceptions of feedback differ when students are unaware of its source. The study is also limited by its use of a specific AI model and a particular set of prompts and predefined instructions. AI-generated feedback is sensitive to how the system is instructed, and different prompts, models, or model versions may produce different feedback. The findings should therefore be understood as reflecting the feedback generated under the specific conditions established in this study rather than representing AI-generated feedback more generally. This limitation is particularly important given the rapid development of generative AI technologies. Finally, the study was conducted within a single semester and focused on relatively short academic texts submitted during the semester. The findings may therefore not transfer directly to longer and more complex academic texts, other disciplines, educational contexts, or levels of study. As expectations for academic writing and feedback vary across disciplines and educational contexts, or levels of study. As expectations for academic writing and feedback vary across disciplines and educational contexts, the pedagogical use of AI-based feedback tools will need to be adapted accordingly. The present pilot study should therefore be regarded as providing a context-specific snapshot of how AI-generated and human feedback may function in relation to relatively short academic texts at the undergraduate level.

Future research

Future research should examine AI-generated and human feedback across larger and more diverse student populations, disciplines, levels of study, and types of academic writing. Studies involving longer and more complex student texts would be particularly valuable in determining whether the patterns identified in the present study persist when greater disciplinary understanding and contextual sensitivity are required. Further research should also investigate how different AI models, prompting strategies, and degrees of transparency regarding the feedback source influence both the characteristics of the feedback and students´ perceptions of its quality and usefulness. Finally, longitudinal studies could provide insight into how students learn to interpret, evaluate, and act upon AI-generated and human feedback over time, and how the two forms of feedback can be combined to support students´ academic development.

Conclusion

The aim of this study was to enhance understanding of how AI-generated feedback can support students´ academic writing in higher education. Drawing on a sociocultural perspective on

scaffolding and the distinction between feed back and feed forward, the findings demonstrate that both the AI assistant and the learning assistants provided feedback that addressed students´ current performance as well as forward aimed at supporting further development. However, the two feedback sources differed in how support was provided. The AI assistant tended to provide more explicit, criteria-focused, and action-oriented guidance, whereas the learning assistants more often contextualized their feedback in relation to the individual student´s text and provided a stronger relational dimension. These findings suggest that AI-generated and human feedback may represent distinct but complementary forms of pedagogical scaffolding. From a sociocultural perspective, scaffolding involves more than providing information about performance; it entails support that helps learners move forward in their learning. While AI-generated feedback may contribute to this process by making assessment criteria explicit and offering concrete suggestions for improvement, human feedback may provide forms of scaffolding that are more responsive to the learner and embedded in dialogue, contextual understanding and relational interaction. Thus, the value of the two feedback sources may lie not in their interchangeability, but in the different ways in which they support students´ academic development. The study therefore contributes to the emerging literature on AI-mediated feedback by moving beyond the question of whether AI can reproduce or replace human feedback. Instead, the findings point towards a complementary model in which AI-generated feedback can provide accessible and action-oriented support, while human learning assistants contribute contextualized, dialogic, and relational guidance. Such a model positions AI as a pedagogical resource, rather than an outside, the social and relational processes of learning. At the same time, the findings should be interpreted in light of the exploratory nature of this pilot study. Further research across larger and more diverse student populations, disciplines, levels of study, and types of academic writing is needed to examine whether these patterns persist in other educational contexts. Research should also investigate how different configurations of AI and human feedback influence students' engagement with feedback, their ability to act upon it, and their development as academic writers over time. Overall, the findings indicate that the pedagogical potential of AI may lie less in replacing human feedback than combining different forms of scaffolding to support student's learning and academic development.

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