Peer and AI Review + Reflection (PAIRR): A Human-Centered Approach to Formative Assessment

1. Introduction

While Generative AI offers promise for reducing equity gaps in writing support, in practice, many interrelated contextual factors impact the effectiveness of technological interventions, and when narrowly implemented, technologies can actually deepen divides (Stornaiuolo, et. al. 2023). We are concerned, for example, by Jiang et al.'s suggestion that AI feedback can be used in MOOCS and in institutions without TAs, which may inadvertently give license to poor pedagogical models, newly bolstered by AI. We are also concerned by the proliferation of AI based EdTech tools like Grammarly and PackBack that are bombarding campuses with advertisements for their new wares, promising to help students write and relieve faculty of the burden of responding to student writing. As Swiecki et al. (2022) point out, "taking human teachers out of the assessment loop is likely to be an appealing prospect for many key stakeholders involved in school and university education." Early critiques of Automated Writing Evaluation (AWE) remain relevant here: "Because all writing is social, all writing should have human readers" (CCCC 2004). Building on these critiques, the MLA-CCCC's Joint Task Force on Writing and AI has recently raised objections to the use of AI for grading (2024). However, could AI play a role in formative feedback (on student drafts) to increase writing support?

Formative feedback has been shown to improve writing outcomes when it is clear, actionable, timely, and specific (Graham et al. 2015; Ferris, 2003; Biber et al., 2011). However, due to the intensive labor involved, instructors often lack the time or resources to provide it, and when students do receive feedback, they are often dissatisfied (Boud & Molloy, 2012). In one of the most robust studies to date, Steiss et al. (2024) found that AI feedback is high enough quality to be used for draft feedback, especially when assignment-specific criteria are used. AI may support educational equity by increasing opportunities for students to receive feedback (Warschauer et al., 2023), but it must be used in a

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human-centered process. Since writing is human communication, humans provide practice for understanding the social and rhetorical dimensions of writing, a key threshold concept associated with learning transfer (Downs & Robertson, 2015). If we remove humans from feedback, we go against the body of research demonstrating that students' relationships with teachers and peers impact their engagement, motivation, and sense of belonging, which in turn correlate with student success and retention (Crawford et al., 2024; Kirby & Thomas 2021; Furrer et al., 2014). Feedback alone does not help students grow as writers: it's students' engagement with feedback that matters (Zhang & Hyland, 2022), and human relationships matter to that engagement (Price, 2011). If students are engaged, recognized and supported, they are more motivated to learn and less likely to drop out (Furrer et al., 2014), and they may also be less likely to misuse AI (Bowen & Watson, 2024).

Another major concern with the use of AI tools is their potential for decreasing student agency, cognitive and metacognitive growth (Darvishi et al. 2024; Molenaar, 2022); therefore, AI pedagogies that emphasize student agency and reflection are crucial. In PAIRR, when students assess AI feedback, rather than taking it at face value, they determine if and how AI feedback aligns with their goals. Thus they are exerting agency while developing AI literacy– defined in this journal as "a set of competencies that enable individuals to know and evaluate AI technologies, communicate and collaborate with AI, and use AI effectively and ethically" (Ranade & Eyman, 2024; Long & Magerko, 2020; Ng et al., 2021) and critically (MLA-CCCC, 2024). When instructors incorporate AI into the feedback process, they shift the emphasis from policing students for plagiarism to using AI for writing support while building AI literacy. When students critically assess AI feedback, noticing how it falls short and when it is relevant to their goals, they begin to understand the constraints and affordances of AI tools. Articulating the rationale for their choices, students engage in the kind of higher order, metacognitive thinking that encourages the transfer of knowledge to other contexts (Yancey 2016).

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To promote pedagogically sound AI feedback integration, writing programs urgently need research-informed guidance. At this point, research on AI feedback is limited. Several studies compare the quality of AI feedback with expert feedback (Dai et al., 2023; Jansen et al., 2024; Steiss et al., 2024). There are few studies based on student responses to AI feedback on their writing, which are limited to individual classes (Cummings et al, 2024; Yu, 2023), or single use with limited course integration (Meyer et al., 2024; Jansen et al., 2024). Byrd (2023) and Mayer (2024) suggest promising ways to incorporate AI feedback into writing processes, including peer review, but those pedagogies have not been formally researched. Some case studies focus on multilingual graduate writers' use of AI, primarily for lower-order concerns (Koltovskaia et al., 2024; Jacob et. al, 2023). Like our model, which pairs AI and peer feedback, Zhang and Hyland (2022) triangulate machine, peer and teacher feedback, but they study AWE rather than AI. Cummings et al.'s (2024) useful DEER Praxis (Define, Evaluate, Explore, Reflect) is an early exploration of several AI tools, but the feedback tool they use, Wordtune, gives revision suggestions as students draft, while PAIRR separates drafting from AI, so that students avoid overreliance on AI. To date, ours is the largest study of AI feedback used by college students, reaching 654 students across 10 distinct writing courses and three large writing-intensive STEM courses. While we implemented ChatGPT 3.5, our approach can be adapted with many different GenAI tools.

The three MLA-CCCC Joint Task Force on Writing and AI Working Papers all acknowledge the importance of including human interactions in the processes of reading and responding to students' writing. These task force reports are not Luddite manifestos, rather, they call for careful, nuanced approaches to integrating AI into students' writing processes. In considering those recommendations, we wanted to know how students perceive AI feedback, particularly in relation to peer feedback. Was AI feedback helpful, and if so, how? Do students see a benefit in using AI with peer review? What do peers offer that AI does not and vice versa? We also wanted to know if an emphasis on assessing AI feedback could increase critical AI literacy (MacArthur, 2023).

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1.1 Peer and AI Review + Reflection (PAIRR)

The PAIRR model (Peer and AI Review + Reflection) connects AI feedback to peer review, a long-standing best practice in writing pedagogy (Anson et a.l, 2023). Student writers' interactions with others about their writing correlates with deeper learning, as well as personal and social development (Anderson, 2015). Moreover, many studies demonstrate that students learn from providing criteria-based feedback (Lundstrom & Baker, 2015; Min, 2006). Because the quality of peer review depends on how well it is scaffolded (Anson et al.,, 2023; Melzer, 2023), GenAI feedback may be an especially valuable addition to peer review in courses across the curriculum, where instructors and TAs commonly lack training in writing pedagogy and where students receive little or no formative feedback.

PAIRR emphasizes reflection and self-assessment and encourages students to be active and critically engaged users of AI feedback, rather than passive recipients who merely follow directions. In order to improve as writers, students need to assess exemplar texts, their own writing, their processes, and the feedback they receive (O'Neill, 2015). Our emphasis on reflection and self-assessment aligns with current scholarship on response, which views students as active participants in constructing response rather than as passive recipients of feedback (Boud and Molloy, 2013; Melzer, 2023; Zhang and Hyland, 2022). While earlier response research focused on teacher feedback, current models see the learner at the center of the response construct; students *use* feedback to regulate their own learning (Boud and Molloy, 2013; Melzer, 2023).

The sequence of the PAIRR process, shown in the flowchart below, reflects our conviction that students should receive AI feedback on their writing after they have completed a draft rather than during the drafting process. Giving students guided practice in assessing AI output, we believe, is also crucial to building AI literacy.

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Fig 1. Flowchart of our Peer and AI Review and Reflection (PAIRR) model. This flowchart demonstrates our model of AI integration paired with peer review.

2. Literature Review

2.1. Automated Writing Evaluation

The large body of research on Automated Writing Evaluation (AWE) systems is relevant to AI feedback research and practice because AI feedback presents many of the same theoretical problems as well as potential affordances. Originally designed in the 1960s for scoring essays (Page, 2003), many AWE systems now focus on formative feedback (Banawan et. al. 2023). Prior to 2020 a great deal of AWE research focused on English as a Second Language (ESL) contexts (Zhang and Hyland 2022; Zhang and Hyland, 2018; Godwin-Jones, 2018). Within AWE systems, students write to fixed prompts and receive scores and formative feedback (Godwin-Jones, 2018), which are often used to encourage

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revision prior to teacher evaluation (Jiang et al. 2020; Grimes and Warschauer, 2010). In practice, however, the utility of AWE formative feedback is dependent on teacher mediation– teachers have to provide significant support for students to interpret AWE feedback (Jiang et. al. 2020; Palermo & Wilson, 2020). Importantly, a great deal of research demonstrates primarily surface-level revisions (for example, Grimes and Warschauer 2010), although increases in student motivation and revision have also been found (Nunes et al.'s 2022; Palermo & Wilson, 2020; Grimes and Warschauer's, 2010).

Writing researchers, computational linguists, psychometricians, and writing program administrators have long struggled with questions about the construct validity and the situational awareness–or lack thereof–of software-driven evaluations or responses to human writing. In their bibliography, "Uses and Limitations of Automated Writing Evaluation Software," Elliot et al. (2013) note that, "These algorithmic models allow machines to produce scores or evaluative comments on measurable aspects of writing, but—as acknowledged by those who design and use them—they do not 'read' student writing as would a human. So, in their present state, these systems cannot judge critical thinking, rhetorical knowledge, or the ability of a writer to adapt to a given audience" (p.1). This tension underscored the need for critical evaluations of AWE systems to ensure they align with pedagogical goals and genuinely support equitable and meaningful writing instruction.

Like AI, AWE has been the subject of intense debate within writing studies, and many scholars have objected to AWE's far remove from meaningful, authentic writing contexts. Whithaus (2006) argued that automated essay scoring tools, despite their efficiency, risk reducing writing assessment to mechanized and reductive processes, reinforcing instructional models that privilege conformity over critical engagement. In 2013, the NCTE issued a potent critique of machine scoring as part of the high-stakes testing ecosystem that shapes instruction and "denies students the chance to have anything but limited features recognized in their writing [...] remov[ing] the purpose from written communication–to create human interactions through a complex, socially consequential system of meaning making."

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Machine feedback is typically viewed by AWE researchers as a complement to human feedback rather than as a replacement, and in practice studies in secondary school contexts did not find teachers ceding control to machines (Nunes et al, 2020; Warschauer & Grimes, 2008; Palermo and Wilson, 2020). Because AWE systems only allow users to write to the specific types of prompts they have been trained on, a process requiring hundreds of essays graded by humans, their uses have been limited (Tate et al., 2024). Generative AI presents bigger challenges and opportunities.

2.2. Generative AI Feedback

Advances in neural network architecture have led to the Large Language Models that underlie chatbots, which can mimic human-like language for a radically expanded range of purposes. AI chatbots allow users to prompt AI for feedback on any type of writing and engage in "conversation" about the feedback. Unlike AWE systems, the LLMs behind chatbots are pre-trained on a vast corpora, so they require no additional training for writing feedback (Steiss et. al, 2024). The large body of research on AWE systems demonstrated modest gains in writing outcomes, but importantly, the feedback in those systems was difficult for students to understand and apply (Jiang et. al. 2020; Palermo & Wilson, 2020), whereas AI feedback is highly readable. AI technology, moreover, is more advanced, and early studies indicate that the quality of feedback is much higher than AWE feedback (Steiss et al. 2024). In their robust study, Steiss et al. (2024) found that while teacher feedback outperformed ChatGPT on most measures, ChatGPT provided relatively high-quality feedback, excelling in criteria-based evaluation. They conclude that AI is high enough quality to play a role in formative feedback but emphasize the need for AI literacy to contextualize its use.

Generative AI, like AWE systems, offers "utility in a fallible tool" (Steiss et al., 2024; Grimes and Warschauer, 2010). Other studies echo Steiss et al.'s finding that AI feedback is potentially useful. In a more limited study, preservice teachers found AI feedback useful 59% of the time compared to 89% for

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expert feedback, although they preferred AI feedback over human feedback 23% of the time (Jansen et al., 2024). In contrast, Dai et al. (2023) found that while ChatGPT's formative feedback for students in a data science course was less reliable than instructor feedback, it more frequently offered writing process feedback, potentially aiding self-regulation. In a larger study of 459 students secondary school EFL students, Meyer et al. (2024) observed that students who received AI feedback showed greater motivation and positive affect, consistent with Nunes et al.'s (2022) and Grimes and Warschauer's (2010) prior findings that AWE tools can encourage revision. In contexts where students typically do not receive formative feedback and spend little time on revision, "the ability to motivate students to spend some time on revision is likely to positively impact writing achievement" (Tate et al., 2024).

An important lesson we can bring from AWE research is that successful implementation of technologies into classrooms requires strong instructional support (Stornaiuolo, et. al. 2023; Nunes et al., 2020; Warschauer and Grimes, 2010). Unsurprisingly, the ways teachers integrate AWE into instruction has a big impact on outcomes, and we expect the same to be true for AI (Nunes et al., 2020). As Whithaus (2006) noted about AWE, software responses can often fall short of fostering the meaningful rhetorical exchanges that peer and instructor feedback provides. Teachers also shape whether writing with technology is a formal exercise or a social and "humanizing practice" (Stornaiuolo, et al. 2023). The research confirms what we know: technologies don't create rich learning environments, teachers do.

3. Methods

3.1. Research Setting, Writing Courses and Participants

We implemented PAIRR in intact writing courses at a large R1 public university in the western U.S. The undergraduate population includes significant numbers of first-generation (37%) and international students (13%) and under-represented minority groups (27%). About 19% enroll as transfer students, typically from community colleges. Unless they test out, all students take two required writing courses,

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usually one lower- and one upper-division. Additionally, all students complete two courses (6 units total) designated as writing-intensive (referred to as WI in this study) and offered across the curriculum by 92 departments. To be designated as WI, courses must provide students with feedback to improve their writing and guidance on the writing process. In practice, these courses are taught by experts in their disciplines who may lack training in writing pedagogy.

For this study, we included some of our own small writing courses, typically taught by trained graduate students and experienced instructors in writing studies, and also recruited three instructors of large WI courses. In recent years, prior to this study and unrelated to AI, the three WI instructors had voluntarily sought and received support to improve writing instruction in their courses from Author 1 or Author 2, in their capacity as Writing Across the Curriculum (WAC) consultants. If needed, we worked closely with these instructors to help them develop their rubrics for the writing assignments to be included in this study, drawing on their knowledge of discipline-specific rhetorical situations and audiences to make expectations clear to students. We collected data from six courses in the winter term and six courses in the spring term of 2024 (see Table 1). Multiple sections of the same course were taught by the same instructors and with the same curriculum. Students in the three lower-division WI courses were mostly non-majors in the relevant discipline (DES, PLA, and ENV), while most students in the upper-division WI course were Ecology or other Environmental Science-related majors (ECO).

Table 1

Participating Course Information

Course Type	**Level**	**Course Pseudonym**	**Instructor(s)**	**Number of participating students**		**Modality**	**Term**

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					Enrolled Students		
Writing	Lower-division	Developmental Writing (DVW)	1 graduate student instructor	16	17	Face-to-face	Spring 2024
Writing	Lower-division	First Year Writing (FYW, two sections)	1 graduate student instructor	49	50	Face-to-face	Winter & Spring 2024
WI	Lower-division	Writing in Design (DSW)	1 faculty instructor; 3 TAs	83	100	Face-to-face	Spring 2024
Writing	Upper-division	Advanced Writing (ADV)	1 faculty instructor	27	27	Face-to-face	Winter 2024
Writing	Upper-division	Health Science Writing (HSW, four sections)	1 faculty instructor	108[1]	100	Hybrid	Winter & Spring 2024
Writing	Upper-division	Application Writing (APW)	1 faculty instructor	7	10	Face-to-face	Winter 2024

[1] The reason for higher response rate than final student enrollment is that some students who were on the waitlist for the class completed the pre-survey. Additionally, some students mischaracterized their course name in the survey.

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Writing	Upper-division	Business Writing (BSW, two sections))	1 faculty instructor	42	50	Face-to-face	Spring 2024
WI	Lower-division	Climate Change (ENV)	1 faculty instructor; 3 TAs	75	90	Face-to-face	Winter 2024
WI	Lower-division	Plant Sciences (PLA, two sections)	2 faculty instructors; 5 TAs	193[2]	184	Online (Asynch. Lecture, synch. Discussion sec	Spring 2024
WI	Upper-division	Ecology (ECO)	1 faculty instructor; 1 Reader	54	69	Face-to-face	Winter 2024

While the small writing courses took a fairly consistent approach to the writing process and peer review, all courses required a range of writing assignments, from cover letters and resumes, to blog posts in health science, to research papers. As well, WI courses varied in instructor support: The face-to-face, upper-division ECO course had no discussion sections and just one reader, and spent almost no time in lecture on writing instruction, with students completing peer review responses for two other students outside of class. In the face-to-face, lower-division ENV course, TAs offered support for the writing process in discussion sections, where students also did peer review in person. In the online, lower-

[2] The reason for higher response rate than final student enrollment is that some students who were on the waitlist for the class completed the pre-survey.

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division PLA course, which had asynchronous lectures and synchronous discussion sections, TAs provided feedback on drafts. TAs and instructors for the PLA course also felt that AI plagiarism was a major problem in the course prior to the PAIRR intervention, and were particularly concerned about multilingual students misusing AI.

The 654 participating students included first-year (17%), second-year (20%), 32% third-year (32%), and fourth-year (27%) undergraduates, as well as fifth-year (3%) undergraduates and graduate students (1%). Ethnicity included Asian/Pacific Islander (37%), White/Caucasian (13%), Hispanic/Latinx/Chicanx (10%), Multiracial (8%), African-American or Black (2%), American Indian or Alaska Native (0.15%), and Other (28% preferred not to answer or gave no response). Most students were U.S.-born (71%), and 68% were multilingual (proficient in English and at least one other language). A small number were International students (4%).

3.2. Research Questions

While our large study explored other questions around Generative AI, writing and AI literacy, in this article we use mixed methods to address two research questions:

1. How are students thinking about AI and peer feedback together? What does each type of feedback offer?
2. How does the PAIRR intervention affect students' writerly agency and AI literacy?

3.3. Procedures and Data Collection

Students were given detailed information about the study at the start of each course, with a consent form allowing them to opt out. Participants were given step-by-step guidance on setting up a ChatGPT account with privacy protections. The intervention was then carried out as follows:

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1) Students read, discussed and wrote brief reflections about a set of short articles on AI, cognition and learning, ethical considerations, and acknowledgment of AI use.

2) Students drafted each writing assignment, provided and received peer review on drafts, and then prompted ChatGPT for feedback, using a prompt we adapted from Steiss et al 2024, as well as the instructor's rubric for the assignment. (see Appendix A).

(3) Students then critically reflected on and assessed both kinds of feedback, considering their goals and audiences, and made revision plans. The instructions reminded students that AI can be wrong, and not to trust it just because it sounds smart.

(4) Students revised and reflected on the process, including the role of AI, peer and instructor feedback in their revisions.

Data collection included: pre- and post-surveys of students[3]; interviews with 4 faculty members and 11 students; focus groups with 8 TAs and 1 Reader; and 654 students' reflections on AI readings, their reflections on and assessments of peer and AI feedback, and their revision reflections. Some instructors provided class time for completing the surveys, and students who participated in interviews received $25 Amazon gift cards.

We administered the pre- and post-intervention student surveys online using Qualtrics, in the first two and the final two weeks of each term. These optional surveys allowed us to understand students' demographics, prior use of and attitudes toward AI, and prior experience with and attitudes about writing feedback from peers and instructors, and the effects of the intervention. In the spring term, on both surveys, we added questions about students' self-efficacy and about whether they continued conversations with ChatGPT beyond the initial prompt (see Appendix A). Students completed the winter surveys at lower rates. Table 2 demonstrates student survey completion by term, illustrating participant attrition in the post-intervention survey.

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Table 2

Number of Survey Responses by Term and Time (Pre- vs. Post-intervention)

Term	Course	Pre-Intervention Survey	Post-Intervention Survey
Winter	FYW	18	17
	ADV	27	4
	APW	7	0
	HSW	52	42
	ENV	68	15
	ECO	54	1
	TOTAL	**226**	**79**
Spring	DVW	16	10
	FYW	21	22
	DSW	79	64
	BSW	40	24
	HSW	54	42
	PLA	154	144
	TOTAL	**364**	**306**

3.4. Data Analysis

We analyzed the survey data using descriptive and inferential statistics, in order to provide background information and general trends from the entire student sample (N = 654). These descriptive statistics included the percentage of students who gave certain responses. The inferential statistics included a binary logistic regression conducted in R using the 'glm' function from the *stats* package, to

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investigate whether students' self-efficacy scores from the Spring survey predicted their decisions to continue the conversation about feedback with ChatGPT after their initial prompt (R Core Team, 2024; Peng et al., 2002). We also conducted a Chi-squared test in R using the 'chisq_test' function from the *infer* package, to examine whether course type predicted students' decisions to continue the conversation about feedback with ChatGPT after their initial prompt (Couch et al., 2021, Larson-Hall, 2016).

Although the survey gathered information about student demographics, course enrollment, their prior use of and attitudes toward AI, and prior experience with and attitudes about writing feedback from peers and instructors, for this article we relied on the survey data in a very limited way: 1) To explore students' preferences for peer or AI feedback or a combination of the two; to explore their opinions about the relative usefulness of peer and AI feedback; and to explore whether students who had a continued conversation with ChatGPT found AI more useful than those who did not; and 2) To ensure, in the coding process, that we sampled a representative range of students.

To explore themes in students' assessments of and reflections on peer, AI and instructor feedback, revision reflections, and interviews, we did thematic coding, following inductive qualitative inquiry (Saldaña, 2021) in MaxQDA. Given the large size of our full student sample, we purposefully selected data from 20% of the students to analyze qualitatively, which resulted in a sub-sample of 131 students. Drawing from the participants' pre- and post-intervention survey responses, we selected participants from each course who had a range of previous experiences with using AI, self-efficacy levels, and language backgrounds. This sampling technique allowed us to report on findings from students with a heterogeneous array of backgrounds (i.e., the sub-sample did not constitute only frequent or infrequent AI users, or students with high self-efficacy as writers, etc.).

The qualitative analysis process began with open coding of documents from a random sample of 15 of the 131 students. All five authors independently generated codes at this stage, based on the

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themes that emerged from the data. We then discussed the open coding results and negotiated coding differences, developing a preliminary codebook. Next, each of the five authors was assigned 20% of the sub-sample documents to code. We applied the preliminary codebook in coding the entire purposeful sub-sample of 131 students. Early in this stage, we met several times, discussed, and revised the codebook accordingly (see Appendix B). Throughout axial coding, we refined the codes as we analyzed more data. Once each author had coded 20% of the data, they completed a second reading of another author's codes. The second readings were staggered so that all of the data received reviews from two authors, ensuring inter-rater reliability. In selective coding, we finalized the resultant codes and themes after reaching data saturation.

4. Results

In the Results section, we focus on insights from and trends among students' reflections on and assessments of AI and peer feedback, which they wrote with every draft writing assignment after receiving peer and AI feedback. Here we rely on our qualitative coding of 131 students we sampled, with additional perspectives from the student surveys.

4.1. Human-Centered AI Feedback

We open with portraits of two students who participated in PAIRR, to show how AI use in this model is deeply embedded within human activity. Irina, a student in the large online course in Plant Sciences, is an engaged learner majoring in Managerial Economics who enjoys writing stories (PLA, P361). She is also a multilingual writer (MLW) for whom English is a third language, which she associates with "some hardships" in writing. Irina reports putting a lot of work into her writing and while, like many MLWs, she is nervous about receiving feedback from others (Sanchez, 2024), she really thinks about feedback and applies it. Irina deeply values feedback from her peers and regularly attends TA office hours, which she finds beneficial and supportive. In addition, Irina finds AI valuable for feedback on

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language issues, organization and focus, and she plans to continue using AI for feedback beyond this study.

Elizabeth is a confident writer and pre-health student in the small upper-division Writing in the Health Sciences course, who received mostly positive feedback from her peers and teacher on a literature review she hopes to publish. Frustrated and wanting to further improve the paper, she was unusual in seeking out feedback from four other people, including two professionals in the biological sciences, as well her peers in the class and ChatGPT. Elizabeth had used AI for feedback prior to the study, and she is well aware of its limitations, particularly in the sciences (HSW, P507). Although she prefers human feedback for its specificity, she finds AI feedback "really helpful" because "it gives me the feedback that I need to be able to continue revising right away," including at 1am, which "definitely helped me stay engaged with my papers." She also felt her work flow became more efficient "because I spent less time staring at my page and more time being like, oh, this isn't working. Let me think about how I can rewrite this to make it work based off of what feedback AI gave me."

It is important to emphasize that for both students, AI supplemented rather than replaced human feedback. In fact, like many students in our study, Irina and Elizabeth preferred human feedback but also found real utility in AI feedback. For both, AI provided a continuous source of support as they revised, when they needed it. These students AI use illustrates how AI can play a supporting role in the writing process, but it is certainly not a replacement for human feedback.

4.2. Similar Feedback from AI and Peers is Reassuring

Our post-intervention survey results from all courses in both the winter and spring terms (N=361) indicate that the majority of all students prefer to receive feedback from both AI and Peers (58%), though a significant portion still prefer peer feedback alone (36%). Notably, 71% of students who

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engaged with AI feedback through follow-up questions preferred combined AI and peer feedback, suggesting that interaction with AI increases its usefulness (included in spring survey only).

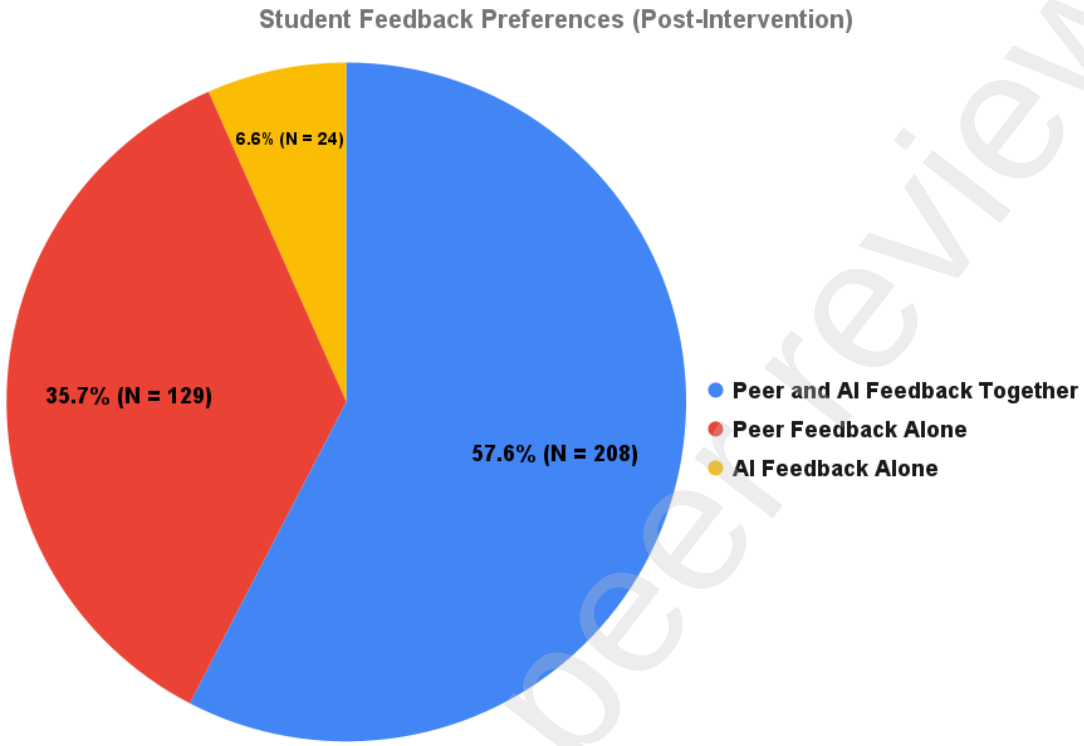


Fig 2. Students feedback preferences on the post-intervention survey. The majority of students preferred to receive peer feedback and AI feedback together.

We attribute students' preference for combined feedback to the fact that 75% of students reported similarities in peer and AI feedback, which were often described as reinforcing each other. This reinforcement is especially important given that students may mistrust peer feedback (Alnasser, 2018), as well as AI feedback:

> Sometimes I would check if, like, AI feedback was kind of similar to what my peers were saying. So it was kind of more of a cross and check thing, and I definitely, I think I wouldn't have wanted

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> to just do one. I did both in every instance for every assignment I have in the course (BSW, P667).

We observed that combining AI with peer feedback increased students' confidence in peer response: "Getting peer feedback first, and then having AI confirm what my peers are saying, gives me more confirmations [sic] on what I need to work on" (FYW). In some cases, AI feedback even "strengthened the idea from the peer" (PLA, P361). Conversely, peer feedback also confirmed AI feedback: "I took the AI feedback seriously as well since it highlighted some of the same areas [as peers] but also provided a different outlook on it" (ENV, P178). Other students echoed this sense that, when AI and peer feedback align, students gain "a different outlook" on peer feedback, which can help clarify what they need to work on: "ChatGPT helped me better understand what my peers were saying" (HSW, P156).

4.3. Different Feedback from AI and Peers Is Complementary

The combination of AI and peer review was also valuable when the feedback differed, addressing distinct aspects of writing in complementary ways; 38% of reflections were coded as "Feedback Consensus: AI and Human Complementary." Both forms of feedback together were valuable: "The feedback from ChatGPT and my peers both provided valuable perspectives on my paper, with each offering insights that complemented and supplemented the other" (PLA, P370). AI feedback was often described as "overly general or generic" (31% of reflections), while peer feedback was frequently described as more specific or detailed (28% of reflections; see Table 3). "Deeper" peer feedback was complemented by AI's broad feedback: "this side by side comparison has shown me that AI is good for finding overarching pros and cons of a paper, while my peers were able to pay attention to small details and include a thoughtful response" (ECO, P141). Another student described AI feedback as "offering a different lens" on their writing (PLA, P581). Combined, peer and AI responses helped some students feel

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they had a "well rounded understanding of [their] paper's strengths and areas for improvement" (PLA, P581).

As seen in Figure 3, students' perceptions of the usefulness of AI and peer feedback were nearly identical, with 312 students agreeing or strongly agreeing that peer feedback is useful and 308 students agreeing or strongly agreeing that AI feedback is useful, though peer feedback generates a higher variation of opinion. It is crucial to emphasize, however, that AI utility was experienced *in the context of human feedback*– only 6% of students preferred AI feedback alone.

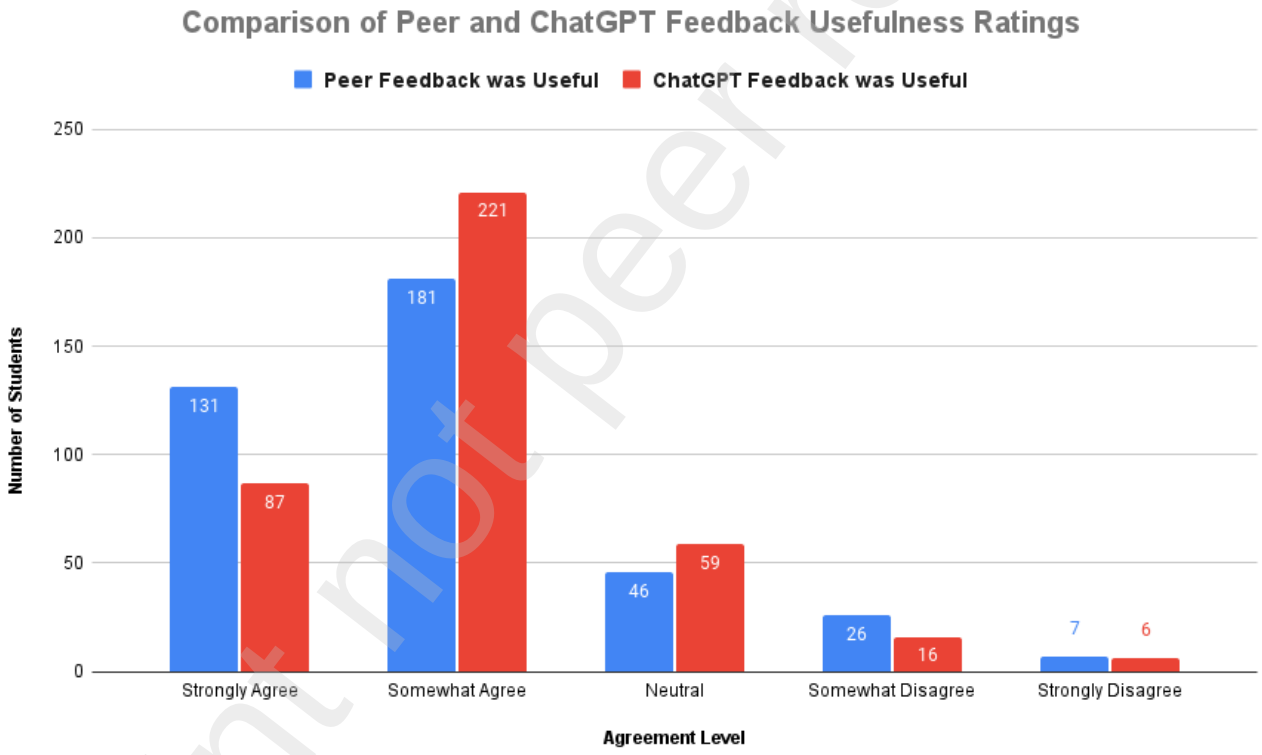


Fig. 3 Usefulness of AI and Peer Feedback. Student Responses to the Questions "I Felt That My Peer Reviewers' Feedback Was Useful" and "I Felt That Chatgpt's Feedback Was Useful" on the Post-Intervention Surveys.

Students identified AI's suggestions for actionable revision strategies, compared to peers' feedback, as one of AI's most useful feedback functions (29% of student reflections were coded for AI revision strategies and another 42% as AI more detailed, which often included revision strategies). One

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student summed up the advantages of AI's critical feedback and concrete revision strategies: "ChatGPT just gave a more thorough explanation of problem areas throughout my paper as well as thorough suggestions for revisions" (ECO, P141). Examples of actionable feedback were: "telling me to go more in depth in specific paragraphs" (PLA, P252), reminding students to synthesize sources and providing advice on how to do so, or prompting students to review transitions and including instructions on transitions. While it is outside the scope of this study to evaluate AI feedback directly, students observed that AI feedback is rubric-driven, which aligns with Steiss et al.'s findings (2024) that AI feedback is comparable in quality to human feedback, especially when criteria are used. One of AI's functionalities, then, is identifying and reminding students of key areas of the rubric relevant to their paper and providing brief instructional strategies to address them. As one student pointed out, however, more feedback doesn't always mean better feedback, and as another observed, AI may not go beyond the rubric, as humans often do.

Interestingly, some students reported that peer feedback focused on lower-order concerns while AI gave feedback on higher-order concerns, such as idea development, argument, use of evidence and organization. This is in contrast to research on AWE systems, which demonstrates that usable feedback is primarily on lower-order concerns (Warschauer and Grimes, 2010)**. I**n our study, students frequently noted that AI addressed structural issues such as organization and transitions (19% of students reflected) and sentence level issues (22%): "[AI] helped me understand the overall structure and flow of my paper, which complemented the more practical and targeted suggestions from my peer and TA" (PLA, P581).

Even among students who found utility in AI feedback, as we saw with Irina and Elizabeth, many valued human feedback even more. And yet, AI can fill an important gap when peers don't provide detailed feedback. Students complained that peer feedback "didn't give me much information" (ENV, P100) because it was too brief, surface level, and/or vague (17% of student reflections). Another

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complaint, particularly in the large online course that assigned one reviewer, is that feedback quality really depends on the peer. Although students appreciated support from their peers, they also felt their needs for critical feedback were often not met: “it was all just like, your paper was great [...], so there wasn't a lot of critical feedback. I'm like, but I need to know [...] where I'm messing up” (BSW, P352). As summarized in Table 3, students reported multiple advantages to peer feedback while AI feedback had other unique and complementary advantages. It is important to note that many students also disagreed with AI feedback (25% of reflections) and/or noted inaccuracies in AI feedback (25% of reflections). Whether students were agreeing or disagreeing with AI feedback, they were asserting agency in assessing AI feedback and deciding whether to use it, a form of AI literacy.

Table 3

Summary of Themes Related to Student Perceptions of AI and Peer Feedback

Students Perceptions of AI and Peer Feedback
AI feedback offers: ● Constructive criticism with actionable revision strategies ● Rubric driven feedback ● Organized and clear feedback ● Feedback on organization, focus, development and transitions ● Feedback on grammar and mechanics ● Positive and critical feedback ➔ Downsides: overly general, shallow, may be inaccurate, lacks contextual knowledge of course and assignment, cannot “see” multimodal compositions or citations
Compared to AI, peer feedback offers:

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- More specific, deeper feedback
- Contextual knowledge of the course and assignment
- An authentic audience
- Knowledge based on personal experience
- Emotional support and community
    - ➔ Downsides: depending on peer, may not be detailed; may be superficial or focus on lower order concerns; may offer positive but not critical feedback

4.4. Peer Feedback Perceptions Compared to AI

Thus far, we have focused on the potential utility of combining peer and AI feedback, but it's also important to understand the continued value of peer feedback in an age of AI. While the majority of students found utility in combined feedback, a sizable 36% of all students surveyed preferred peer feedback alone. Students felt that peers provided feedback that was more specific (28% of students reflected) and helpful (39%), as well as insightful, deeper, more relatable, and creative. One student insightfully noted that, because their peers were working on the same assignment, peers were also more attuned to its challenges and strategies for addressing them. Relationships with peers were also important and peer review fostered connections with classmates that engaged and supported them: "my peers kept an encouraging and supportive tone" (BWS, P362). Peer reviews from classmates matter, not only because of the specific feedback offered, but also because of the relationships built among students. In face to face classes, students appreciated building relationships through peer review, "I felt better getting feedback from my friends because of the connection it gave me" (DVW, P310). AI feedback can be valuable, but it lacks the situational awareness and the interpersonal weight

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that peer review provides. In short, AI feedback does not build the human-to-human relationships that are vital for writers' development.

Humans have access to specific contexts that AI does not, and accordingly, some students found greater value in peer feedback because their peers understood the assignment, course context, and subject matter more deeply than AI (15% of reflections Understands Assignment/context): "peer feedback gave an insider perspective, with the knowledge that was given from the assignment file and the class" (EMS 141, P73); "they were much more aware of what was expected from this paper than the AI tool was" (ENV, P205). Based on this contextual knowledge, many of these students trusted their peers more than AI: "it is coming from a real person who understands this class and assignment on a genuine level" (PLA, P502). Some students experienced AI as lacking in those human qualities "it lacks that human feel and thoughtfulness… [the] humanity behind the feedback" (ECO, 141). While technology may offer support, we should pay very close attention to students' needs for "humanity" and "real feedback" (ECO, P141), which is linked to their engagement with learning (Price, 2011)

Some students enjoyed getting feedback from peers as an authentic audience, which increased their audience awareness (16% of reflections). Writers also appreciated their peers' subjective and emotional responses as human readers, which encouraged rhetorical awareness. As Elizabeth, one of the frequent AI users, shared: "It was good to have someone with human emotions to be able to read it and reflect on how my writing came across [...] I think some of my writing came across as scary, like, discouraging people away from my [patient care] topic" (HSW, P507).

4.5. Feedback Preferences and Continued AI Prompting

While AI prompting was not the focus of this study, it emerged as an important theme that we briefly discuss here. The PAIRR intervention used one-shot AI feedback, but we gave students the option to ask ChatGPT additional questions for feedback on specific areas. On the spring post-intervention

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survey (n=386) and student interviews (n=8), we added a question about continued feedback conversations with ChatGPT. We learned that 35% of students continued a feedback conversation with AI. Among students who continued AI feedback conversations, 71% preferred AI and peer feedback together, while among those who did *not* continue the conversation, only 46% preferred AI and peer feedback together. These findings indicate that students who continued feedback conversations with AI perceived more utility in AI feedback.

We wondered if students with higher self-efficacy were more likely to continue conversations with ChatGPT. We thus ran a logistic regression analysis to assess whether students' self-efficacy scores (ranging from -2 to +2) predicted their decision to continue the conversation with AI (1) or not (0). We found that self-efficacy scores did not predict students' decision to continue the conversation [$z(277) = -1.125$, $Pr(>|z|)=0.260$; see Table 4]. It should be noted, however, that because the spring sample (N=386) includes a large online class (PLA, N=193), they are disproportionately represented, so these findings should be considered within that course context, especially given that students received only one peer review response. We also wondered if students in larger courses with less writing support were more likely to engage in continued feedback conversations with AI. We ran a Chi-squared test to determine whether students' decision to continue the conversation differed between small writing classes and large WI classes. We found that student feedback preferences were not statistically different in large WI courses compared to small writing classes [$\chi2(1) = 0.701$, $p = 0.402$; see Table 5].

Table 4

Self-efficacy Scores: Continued the Conversation with ChatGPT vs. Not (Only Spring Survey)

Group	Sample Size	Mean Self-Efficacy	SD Self-Efficacy

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	(students)		
Continued the Conversation	104	1.037	0.639
Did Not Continue the Conversation	174	1.122	0.584

Table 5

Distribution of Continued the Conversation with ChatGPT vs. Not by Course Type (Only Spring Survey)

Feedback	**Course Type**	**Number of Students**
Continued the Conversation	Writing	57
	Writing Intensive	47
Did Not Continue the Conversation	Writing	85
	Writing Intensive	89

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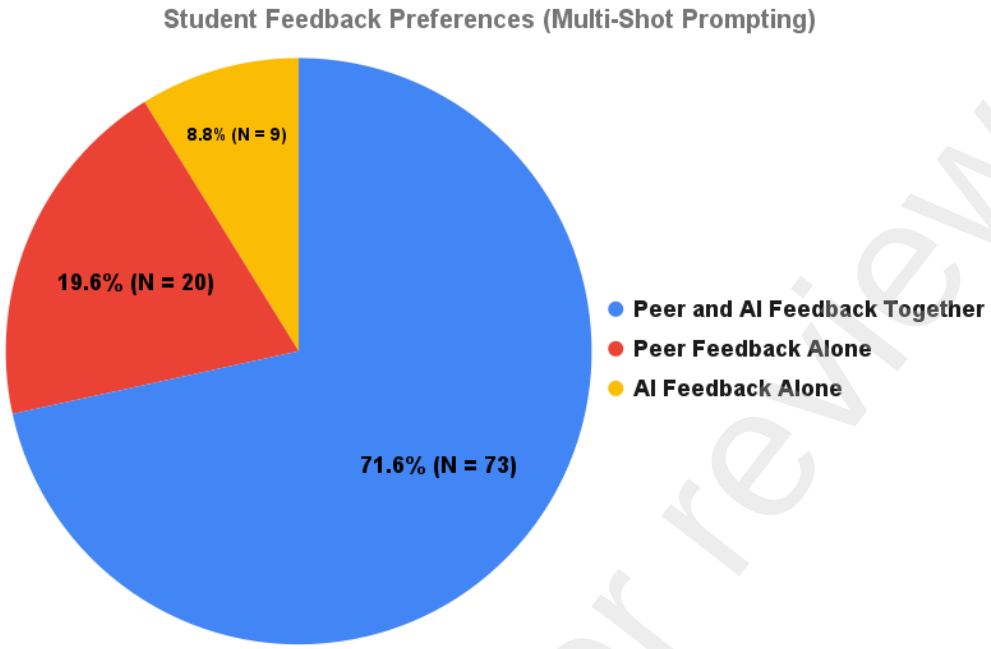


Fig. 4. Feedback preferences among students who engaged in multi-shot conversations with ChatGPT. Students in this group were more likely to prefer peer and AI feedback used together compared to other feedback options.

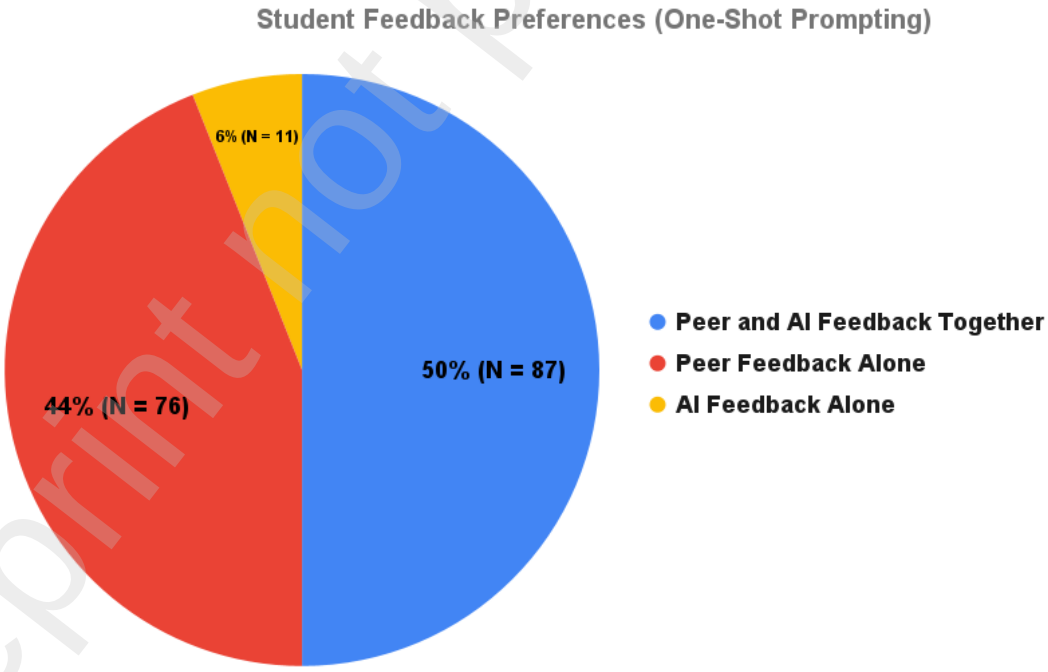


Fig. 5. Feedback preferences among students who engaged in one-shot interactions with ChatGPT. Students in this group were equally likely to prefer peer and AI feedback together as either alone.

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Of course, whether or not a continued conversation with a chatbot is perceived as useful depends on a number of factors, including skill in prompting. We return to Irina, who learned to prompt ChatGPT for the specific types of assistance she needs, a useful form of AI literacy, "if you post the question correctly and ask for details and samples [from your draft], it really provides you the specific sentences and specific parts where you should work on it more" (PLA, 361). Like Irina, Elizabeth identified prompting ChatGPT for feedback as an important skill, one which she points out is challenging:

> If a prompt maybe isn't giving you quite what you need from it, you can always adjust and be like, No, actually, focus more on this [...] I feel that I am able to effectively create prompts for it that give me good feedback. And I think that's a big challenge, trying to figure out how to get what you need from it, but that's something that I feel pretty confident in (HSW, P507).

As Mollick has discussed, prompting plays an important role in eliciting high-quality outputs (2023). Assessing the impact of student prompting on feedback utility is an important area for future research.

4.6. AI Literacy and Writerly Agency

Assessing AI feedback helps students develop AI literacy because they practice evaluating AI outputs for accuracy and relevance to their own writing, develop an intellectual and practical knowledge of these tools, including their affordances and limitations in a particular capacity, delineate an ethical role for AI within their writing processes, and articulate the rationale for their choices (Ranade & Eyman, 2024; Long & Magerko, 2020; Ng et al., 2021; MLA-CCCC, 2024). Students demonstrated many different forms of AI literacy in their reflections. Many students skeptically evaluated AI outputs (25%) and noted inaccuracies or stated that they disagreed (25%): "what I learned from this is that AI can be helpful, but as always, it is critical to evaluate the feedback for relevance and correctness (HSW, P509). Students also observed when AI feedback simply didn't align with their goals (13%), including some instances when

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feedback was not aligned with the assignment: “I may not implement that as I do not think the prompt requires me to come up with ideas on how to solve the issue” (ENV, P178).

Students also demonstrated a growing AI literacy by delineating a limited role for AI in the writing process (25%). As one student described: “Asking AI for ideas on how to format your writing could help you get a sense of how to make your writing flow better. AI can be used to help build the skeleton of your writing, but the meat of it should be written by a person” (ADV, P156). We were especially encouraged by students who felt they learned an ethical way to interact with AI tools: “I feel a lot more comfortable using ChatGPT in an ethical way to support my writing” (ECO, P141). Or as another student put it, “I definitely learned the correct ways to use AI, and it is definitely not the copy, paste a prompt into the generator and make it write my essay for me” (BSW, P362). Other students shared that they gained the knowledge they need to use AI for feedback in the future: "I'm kind of grateful that he opened the door for me to learn about it, because I can use it for future pieces of writing, and I know how to use it, which is very helpful" (FYW 1, P445). In their reflections, students demonstrated emerging AI literacy, including a knowledge of how to use AI ethically in the future, which using AI for feedback helped them to build.

AI literacy and writerly agency are intertwined and reciprocal. Writers must assess whether AI feedback aligns with their goals, audience, genre, context and assignment, a form of AI literacy that exercises agency and metacognition, as called for in the MLA-CCCC Joint Task Force Working Paper on AI Literacy (2024). We found that when students had to assess multiple forms of feedback, negotiate between them, and articulate their rationale, they not only made decisions about *whether* to take feedback but they also thought about *why*:

> I do agree with [peer and AI feedback]. I think oftentimes I find myself rushing through writing that I need to remember to write so others can understand and follow. I definitely want to take

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> reorganizing my paragraphs and wording into consideration to better fit the readers needs. (PLA, P622)

Many writers strongly conveyed to us that they were making their own decisions rather than blindly trusting AI: "*I made an executive decision* on whether to change it or not" (ENV, P103). Within our reflective model, very few students demonstrated overconfidence in AI judgements (5.3%). Rather, a typical sentiment was: "I could pick out what feedback made sense to me, and others that didn't, similar to peer review" (DSW, P580). A multilingual student described agency at work in this process: "If peer and AI make the same suggestions, I can deepen their determinations. On the contrary, if they put forward different opinions, I can also make a judgment on how to modify" (PLA, P648). This critical evaluation of ChatGPT output stands in stark contrast to students we have seen accepting in-text revision suggestions in Grammarly without really thinking about their choices. We did, however, identify 3 out of 193 participating students from the large online class (that had prior plagiarism issues) whose reflections we suspect were written by AI.

In PAIRR, writers carefully assessed the feedback that they received and decided what feedback aligned with their goals and the assignment. This type of analysis, which we saw in many students, moves writers beyond fixing issues in the paper at hand, towards developing explicit knowledge about writing. Not only did students practice metacognition when making revision decisions, but students who used AI feedback frequently reported that it helped them to identify recurrent writing problems. For example, AI feedback helped Irina to "notic[e] tendencies [...] that I have to look out for" (PLA 361) while Elizabeth believed AI "helps me improve by pointing out bigger picture issues with things like clarity and flow of my writing, and kind of helps me identify patterns in my writing" (HSW 507).

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5. Limitations

While we expected to see differences in student feedback preferences among large WI courses and writing courses, in fact, feedback preferences did not differ in statistically significantly ways. Nevertheless, due to the large size of the online PLA course, those students were overrepresented in our sample, so that course context should be kept in mind, particularly since students were only assigned one peer reviewer who they did not meet in person, while in all other courses, students received feedback from two peers.

In addition to course mode, other factors may have impacted students' perceptions of AI utility including rubrics, which varied among courses, assignment prompts, assignment type and genre. Many students' perceptions of AI utility changed across assignments, and we suspect more detailed rubrics produced better feedback. In addition, ChatGPT 4.0 was released in the middle of the spring, and while we instructed students to keep using version 3.5, it was not always clear in the ChatGPT interface which version was being used, and access to 4.0 was variable. Additionally, except in our section on prompting, our analysis does not distinguish between students who used one-shot feedback versus those who continued conversations with AI.

6. Conclusion

While AI tools offer writing support, they must not replace human feedback in the writing process. On quantitative measures, students' perceptions of AI usefulness were surprisingly high (308 students), nearly identical to peer usefulness (312). We must keep in mind, however, that high AI utility was found in the presence of human feedback— only 6% of students surveyed preferred AI feedback alone. Given the real limitations of AI feedback, it's remarkable that 58% of students surveyed found the combination of AI and peer feedback useful. Among students who continued feedback conversations 71% preferred the combination, suggesting that continued conversations may increase AI feedback

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utility. Assessing the impact of continued feedback conversations on AI feedback utility is an important area for future research.

It remains critical to recognize, however, that students' responses to AI feedback varied, and 35% of surveyed students preferred peer feedback alone (19% of those who continued conversations). There may be many factors at work in student preferences, including individual student learning dispositions (Driscoll and Wells, 2012). Some students found peer feedback valuable and satisfying in ways that AI feedback was not, for "deeper" feedback rooted in course context, and for human connection with "real people" who provide "real feedback" (ECO, P141).Human interaction around writing is crucial to engagement (Zhang & Hyland, 2022; Price, 2011), which is important to motivation, learning, and equity (Furrer et al., 2014). While we did not find differences in AI feedback preferences between students with lower and higher self-efficacy levels, this is another important area for future research with implications for educational equity.

Response models that incorporate AI should emphasize reflection so that students practice metacognition, develop writerly agency and cultivate AI literacy. In using AI for feedback and assessing that feedback, students *experience* the affordances and limitations of AI tools more generally, and specifically as part of the revision process. In reflecting on their experiences and articulating the rationale for their choices, students consolidate their *knowledge* about GAI tools. These are important forms of AI literacy, and they are also the types of metacognitive processes that help move writers from implicit to explicit knowledge and are associated with transfer (Yancey, 2016). In "Reconstructing Response to Student Writing," Melzer (2023) argues that student self-assessment should play a central role in response, including peer review. At this moment, it may be more important than ever to involve students in assessing their own writing, processes and feedback, "turn[ing] our attention to students' own critical self-reflections on these choices and processes" (p.33). As evidenced by the reflections in

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this study, students are very capable of critically assessing their processes with AI and making choices that align with their writing goals.

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Declaration of generative AI and AI-assisted technologies in the writing process

During the preparation of this work Author 1 used ClaudeAI to help rephrase three sentences and to condense the abstract (the shortened version for Elsevier only). After using this tool, Author 1 reviewed and edited the content as needed and takes full responsibility for the content of the published article.

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Appendix A: AI Feedback Materials

How to Ask ChatGPT for Feedback on Your Draft

After peer review of your draft, you will complete **steps 1-4**.

- When you are done create a file and paste: 1) the feedback you received from ChatGPT and 2) your memo

After your revise your paper, you will complete **step 5**. Please submit:

- A memo to your instructor, labeled "Revision Reflection," included at the bottom of your final revision.

STEP 1: Set Up ChatGPT

- Log into ChatGPT (if you do not already have an account, create a free account using your email)
- Open a "New Chat"

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- **Privacy:** To protect your privacy and intellectual property, please use ChatGPT in "incognito mode": "By default, OpenAI will use the messages you send to ChatGPT to 'train and improve' its models. But users have the power to stop this from happening by using the platforms' incognito mode. To activate it, open ChatGPT in your browser, click your username on the left, go to Settings, and next to Data Controls click Show. Once there, turn off the Chat History & Training toggle switch."

STEP 2: After peer review, get feedback from AI

- You will need:
  - Full Assignment Prompt and Rubric
  - Your draft or work in progress
- Copy and paste the entire message below into the Chat Box, making sure to replace the red text with the appropriate information.
- Optional: To receive more detailed feedback, consider limiting the grading criteria to the specific areas you think would benefit you the most (i.e. deleting all the criteria except for what's contained in the "Ideas/Evidence" section, etc.)

CHATGPT PROMPT:

I am a student in a university writing course working on a paper. Pretend you are a peer-reviewer who will review my draft based on the assignment prompt and grading rubric I provide. Please provide clear, detailed, specific, and supportive feedback. The format for your feedback should be as follows: 1. Two to three positive aspects of my paper and why those aspects are effective. 2. Three to four aspects for revision and the reasoning about why each poses an issue, and 3. A suggestion for revising each one.

Here is the assignment prompt: [copy and paste assignment prompt]

Here is the rubric for the assignment: [copy and paste rubric].

Here is the paper: [copy and paste draft]

STEP 3: Analyze AI Feedback

- Carefully read through ChatGPT's feedback
- Remember that ChatGPT often makes mistakes, overlooks things, and makes up information–so consider each piece of feedback and suggestion and compare it to your own understanding of the assignment goals and grading rubric.
- Make notes on what is helpful and unhelpful in this feedback and consider your plans for revising your work.

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STEP 4: Write the First Reflection: "Peer and AI Feedback Assessment"

As soon as you receive feedback from your peers and ChatGPT on your draft, please write a memo (a full paragraph) to your instructor following the prompt below. Label it "Peer and AI Feedback Assessment."

**Write this first reflection BEFORE you make any revisions, and include it at the top of your final version of the assignment.*

(NOTE: This is low-stakes writing; please don't worry about grammar, correctness or "sounding smart.")

- First, c*arefully summarize* the feedback you received from your peers, and the feedback you received from AI, highlighting where the feedback overlaps and where it contrasts.
- Then consider the following questions:

1. Do you agree with the feedback? What advice do you want to take/why? What advice do you disagree with/why?
2. How does ChatGPT feedback compare to feedback you received from your peers? Did you gain any perspective from ChatGPT that you didn't get from peers? Did peers give you any perspective you didn't get from ChatGPT?
3. How did you ***feel*** about getting feedback from AI compared to feedback from peers?
4. What aspects are most important to focus on in your revision?

STEP 5: After You Revise, Write the Second Reflection: "Revision Reflection"

Write a memo (a full paragraph) to your instructor at the top of the final version of your assignment. Label it "Revision Reflection."

When you turn in the final version of your assignment, be sure that you have included at the top both the"Peer and AI Feedback Assessment" and the "Revision Reflection."

(NOTE: This is low-stakes writing; please don't worry about grammar, correctness, or "sounding smart.")

We are interested in learning more about how you actually used feedback from peers and from ChatGPT.

- First, *please describe* the most important revisions you made to this paper.
- Then consider the following questions:
  1. How did you realize you needed to make each of these revisions–through peer review, AI feedback, rereading your own writing, or TA feedback?
  2. What did you learn about using ChatGPT as part of your writing process? Did ChatGPT feel like a tutor? A collaborator? Or something else?

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Appendix B: Codebook

Category	Code	Sub-code	Additional sub-code
AI Feedback	AI Positives	Immediacy	
		Orients to rubric/ assignment	
		Use of evidence/ sources	
		Increased audience awareness	
		Organization/ structure/ transitions	
		Sentence-level feedback	
		Helpful	
		Feedback is organized/ clear	
		Explains revision strategies	

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		More detailed	
		Better	
		Unbiased/ Impersonal/ Safe	
		Less time consuming	
		Triggers metacognition	
		Other	
	AI Negatives	Inaccurate	
		Lacks contextual or rhetorical awareness	
		Overly general/generic	
		Other	
	AI: Neutral Assessment		
	Affect and AI		
		Mistrust	

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		Impersonal- negative (alienating)	
		Unengaged	
		Other-negative	
		Motivating	
		Impersonal- positive	
		Trust	
		Feel supported	
		Other-positive	
		Demotivating	
		Engaged	
Peer Feedback	Positives	Audience awareness	
		Triggers metacognition	
		Use of Evidence/ Sources	
		Different perspective on own writing	

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		Valuable/ better/ more helpful	
		Helpful	
		Understands assignment/ more knowledgeable	
		More detailed/ specific	
		Human Connection	
		Encouraging/ Increases confidence	
		Other	
	Negatives	Bare bones	
		Other	
	Affect & Peers	Personal/ relational	
		Feel Supported	
		Feel Engaged	
		Trust	

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		Mistrust	
		Motivating	
		Feel unengaged	
		Don't feel supported	
		Demotivating	
Instructor Feedback	Positives	Knowledgeable/ Content guidance	
		Someone cares	
		Other	
	Affect & Instructors	Personal/relational	
		Feel supported	
		Feel engaged	
		Trust	
		Motivating	
		Not engaged	
		Demotivating	
		Don't feel supported	

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	Negatives	Too critical	
		Too nice	
		Other	
Feedback Consensus	AI and human feedback similar		
	AI and Human: Complementary perspective		
	AI and human do not overlap		
	AI and Human Feedback disagrees		
	AI and Peers together trigger metacognition		
Writerly Agency			
AI Attitudes	Problematic AI	Student Misused	

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	attitudes or use	ChatGPT	
		AI might make me lazy	
		Overconfidence in AI judgements	
		Temptation to cheat	
		other problematic attitudes	
	Signs of AI literacy	Skeptically evaluating AI output	
		Recognizes lack of rhetorical/ contextual knowledge	
		Feedback doesn't align with my goals	
		Disagreement/ Notes inaccuracies	
		Delineates limited	

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		role in process	
		Desire to maintain voice/ control over writing	
		Ethical concerns about AI	
		Other	First time using ChatGPT for feedback
			Surprise at quality of AI feedback
			Understands why to use AI but reluctant

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Peer and AI Review + Reflection (PAIRR): A Human-Centered Approach to Formative Assessment

Lisa Sperber **(Corresponding author)**
University of California, Davis
Writing Center
1 Shields Avenue, Davis CA 95616
ldsperber@ucdavis.edu
https://orcid.org/0009-0009-1689-759X

Marit MacArthur
University of California, Davis
Writing Center
mjmacarthur@ucdavis.edu
0009-0003-7862-2707

Sophia Minnillo
University of California, Davis
Department of Linguistics
smminnillo@ucdavis.edu
https://orcid.org/0000-0002-8962-7920

Nicholas Stillman
University of California, Davis
Department of English
nstillman@ucdavis.edu
https://orcid.org/0009-0005-6467-9096

Carl Whithaus
University of California, Davis
University Writing Program
cwwhithaus@ucdavis.edu
https://orcid.org/0000-0002-3790-6696

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