

Two frameworks to guide discussions around levels of acceptable use of generative AI in student academic research and writing

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The capacity of generative AI tools, such as ChatGPT, to perform at human-like levels on a range of tasks has created a challenging pedagogical tension within education. On the one hand, such tools pose significant threats to academic integrity, but on the other hand, employers will also expect graduating students to be proficient in the use of such tools so as to improve their productivity and performance levels. How best to balance this tension and produce students who can both work proficiently with discipline-relevant generative AI tools and also add significant value to anything a generative AI system can produce will be a long-term research project for educators. In the short term, however, since many students are already widely using or exploring the use of such tools, it is important for educators to clearly delineate for students what level of use is acceptable or unacceptable for each assessment task. To help educators frame any discussion with their students about levels of acceptable use, this paper proposes two frameworks for the uses of generative AI to support academic writing. The first framework is relatively simple, and generalises ideas from long term discussions around the support-collaboration-collusion continuum to the case of generative AI support for academic writing. The second proposed framework is two dimensional, considering the different levels of support possible at each of six stages in the academic writing process. In addition, since helping students learn effective “prompt engineering” will need to be a pedagogical goal, use examples at each level of the second framework are provided, together with commentary about effective prompt engineering, issues to watch out for, and possible ways to acknowledge any such use. It is hoped that the analyses and examples provided in this paper will provide useful foundations for both discussions between educators and their students, and future research into how best to integrate the use of generative AI tools in higher education pedagogy. Some suggestions for the needed research are also given. Since similar issues as those discussed above arise for research students when writing for publication, some discussion of these issues in relation to (evolving) academic journal policies in this area is also provided.

Key Words: Generative AI; academic integrity; academic writing pedagogy.

1. Introduction

1.1. Motivating context: On why generative AI is now a “double-edged sword” for higher education

The public and free to use release of OpenAI’s “large language model” (LLM), [ChatGPT](#), at the end of November 2022 has caused considerable consternation in educational circles, including at the tertiary level. One cause for this consternation is the capability of the chatbot to perform at pass or even higher levels in exams in a range of disciplines,¹ causing concerns that students might use it to cheat in online exams. The subsequent release of the more advanced model, [GPT-4](#) (ChatGPT is powered by GPT-3.5), only increased that concern as this model has been shown to be able to perform better than the majority of humans taking exams such as the US’s GRE, AP and SAT tests (see Figure 4 and Table 1 in [OpenAI \(2023\)](#)).

Another cause for consternation has been the capacity of ChatGPT to perform [passably to competently on almost any writing task it is set](#)² (Scharth, 2022), including essays and creative writing tasks. This capacity led to early headlines opining views such as:

- [“The College Essay Is Dead”](#) (Marche, December 7, 2022)
- [“The End of High-School English”](#) (Herman, December 9, 2022)
- [“How ChatGPT and other AI systems may ruin the ability to write \(and think\)”](#) (Geher, January 6, 2023).

Pieces like these voice concerns that ChatGPT and similar generative AI (hereafter GenAI) tools pose a threat to academic integrity identical to that of “contract cheating”, but without the need for a contract. As a result, university academic integrity policies have been updated to include student use in assignments of unattributed or unacknowledged content produced by a GenAI tool as a form of plagiarism (see, e.g., [“Summary of Institutional Responses to the use of Generative Artificial Intelligence”](#), May, 2023).

The “flip side” of both the above concerns is the possibility of using GenAI tools to *support* student learning and writing development. For example, in relation to learning, the [Khan Academy](#) is beta testing the coupling of the LLM GPT-4 with the mathematical computational power of [Wolfram Alpha](#) to provide maths students with [competent maths tutoring by an AI](#) (Sal Khan, April 24, 2023). ChatGPT can also support student learning by being used to “explain <content> at the level of a 12 year-old”, generate multiple choice questions or short answer questions at all the levels of Bloom’s taxonomy of educational objectives on a topic or on a body of text “fed” to it, including with answer keys or in a two-column, question and answer format, and more³ (see for example, [“How to Use GPT-4 to Easily Learn Any Skill \(7 ChatGPT Prompts for Studying\)”](#))

¹ E.g. [Introductory Astronomy](#), [AP Lit](#), [USMLE](#), a [linguistic IQ test](#).

² Formatting note: throughout the text, hyperlinked text which is either an exact quote from the source or the exact title of the source is placed in quotation marks. If the hyperlinked text merely paraphrases or describes an idea from the linked source, then quotation marks are not used.

³ However, it is important for students using GenAI in the above ways to be aware that ChatGPT is known to “hallucinate”, that is, it can quite *confidently* present users with factually or conceptually incorrect information. Consequently, all GenAI-generated content needs to be independently fact checked. For an accessible article which explains with the use of an analogy why LLMs “hallucinate”, see Ted Chiang (February 9, 2023): [“ChatGPT Is a Blurry JPEG of the Web”](#). The analogy that ‘an LLM “offers paraphrases, whereas Google offers quotes”’ (Chiang, 2023, as cited in Teubner et al., 2023, p. 99) may also provide useful insight. A more technical discussion of how LLM’s work is given in [“What Is ChatGPT Doing ... and Why Does It Work?”](#) (Wolfram, February 14, 2023). Although this is a very long post, reading just the opening section, “It’s Just Adding One Word at a Time”, is enough to understand why some commentators have called LLMs, [“stochastic parrots”](#), and should provide a salutary lesson against anthropomorphising LLMs. However, it should also be noted that some experts think [ChatGPT has gone beyond being simply a stochastic parrot](#).

(Young, May 7, 2023), and [The Learning with AI initiative from the University of Maine \(umaine.edu\)](https://umaine.edu)).

Regarding support for writing development,⁴ ChatGPT can be used to help writers in several ways (see Section 2 for some examples), including asking it to “act as a writing tutor” when providing feedback (for examples, see the Appendix: [Stage 6: Editing and revision](#)). In addition, early tests of ChatGPT for providing feedback to students on a university level business data science project proposal indicated ChatGPT typically provided more comprehensive and more readable feedback than did the marking academics, but tended to be an “easier marker” in terms of feedback on the standard obtained (Dai et al., 2023). However, this latter weakness may be addressable with better prompt engineering. See also, “[Could ChatGPT mark your students’ essays?](#)” (Christodoulou, January 10, 2023). For further interesting discussions of the “double-edged sword” nature of GenAI for higher education, see Lim et al. (2023).

The focus of this article will be on academic writing by students,⁵ doctoral as well coursework. Consequently, the above potential uses of GenAI systems to support the *learning of content* will not be explored any further. Other potential uses of GenAI, such as converting text to an image, audio or code, will also not be discussed.⁶

1.2. Why is there a need for frameworks for discussing GenAI use in academic writing?

The “paradoxical nature” of GenAI (Lim et al., 2023) for higher education identified above also comes to light when reflecting on the [Higher Education Standards Framework \(Threshold Standards\) 2021](#). These *Standards* state on the one hand that,

The specified learning outcomes for each course of study encompass ... knowledge and skills *required for employment* and further study related to the course of study [2(c)] [Italics added]

which implies the need for students to develop their “AI literacy”⁷. This need is widely acknowledged in the tertiary sector, as reflected by the following excerpt from a [post on 2 May 2023](#) by the ANU’s Pro Vice-Chancellor (Education and Digital), Professor Maryanne Dever, who noted that:

the application of AI tools in some professions is growing and students need to be able to use them effectively. We know that AI is going to disrupt work practices across different industries and we want to ensure our students understand how to operate effectively with AI.

The need for students to develop AI literacy for their future employment is also implied by early research demonstrating substantial productivity gains “in the context of midlevel professional

⁴ It has also been argued that “[AI tech like ChatGPT \[could\] improve inclusion for people with \[a\] communication disability](#)” (Hemsley et al., January 19, 2023).

⁵ It should also be acknowledged that GenAI tools can be of great benefit to instructors, helping speed up the process of writing marking rubrics, developing lesson plans and illustrative examples for lessons, and so on. For further discussion of such uses, see Mollick and Mollick (March 17, 2023); “[Artificial intelligence is already changing how teachers teach](#)” (St. George & Svrluga, July 13, 2023), and “[I Asked ChatGPT to Develop a College Class About Itself: Now, it’s teaching it](#)” (Maynard, July 16, 2023).

⁶ Table I in the review article by Aydın and Karaarslan (2023) provides a comprehensive list of GenAI applications and AI tools for those applications at the time of writing.

⁷ A thorough analysis of the concept of “AI literacy” is given in a review article by Long and Magerko (2020). The discussion in this paper has one minor gap, however, and that is that the ethical uses section only considers issues from the world of work perspective; ethical use by students is not considered.

writing tasks”, both in terms of reductions in the time taken to complete such tasks, and writing quality (Noy & Zhang, 2023).

On the other hand, however, the *Standards* also state that,

Methods of assessment are ... capable of confirming that all specified learning outcomes are achieved and that grades awarded reflect the level of student attainment[,] [3]

and this standard is threatened if students can use GenAI to pass assessment tasks with minimal effort on their part.

How best to manage the above tensions is still an area of intense debate and investigation, with a thorough overview of the thinking and issues as at June 8, 2023 being provided by [Liu and Bridgeman](#). These authors propose placing any piece of student work on a two-dimensional grid, where one axis indicates the level of human input from low to high, and the other axis indicates the level of AI input from low to high. The axes running through the middle of each continuum thus leads to four quadrants. However, as pointed out by Liu and Bridgeman, much of the early discussion about AI and academic writing has been in these authors’ “low human contribution, high AI contribution quadrant”, which poses a threat to academic integrity in that it is not clear how much students will learn by working in this quadrant. To meet the dual goals of developing and assessing students’ disciplinary knowledge and competence, *and* their professional AI use competence, however, will require assessment tasks that require *high* levels of human contribution and *varying* levels of AI contribution, with the level of AI use acceptable depending on the year level of the student and the desired learning outcomes (see Section 4.1 for further discussion of this point). Hence there appears to be a need for something like the human-AI writing continuum model proposed in Section 2 below.

How to design assessment tasks which require different levels of AI use (including none at all), and what tasks should be given to students at what level of their education lie outside the scope of this paper. Rather, the goals of this paper are to:

1. Provide in Sections 2 and 3.3, nuanced and fine-grained frameworks on GenAI use for academic writing to guide discussions by academics, and by academics with their students, about what sorts of GenAI use are acceptable for any given assignment, and how such use should be acknowledged / documented (see Section 3.1).⁸ That is, one goal is to collate and organise the many ideas that have been discussed in published sources so far, and provide some additional ones as well.

⁸ Higher degree by research (HDR) students writing for publication, and academic language and learning educators working with such students, will also need to be aware of the policies around AI use of major publishing houses. I suggest that these policies could also benefit from the nuanced and fine-grained frameworks discussed in this paper for the following reasons. As will be discussed in Section 4.1, some of the major scientific journal publishers do not allow the use of generative AI tools in the writing of scientific papers, apart from using such tools to “improve [the] readability and language of the work”. This limitation arises out of concerns that using GenAI tools to write the actual content of scientific papers could result in issues such as plagiarism, copyright infringement and the publication of fabricated / “hallucinated” content. However, as Framework 2 (see Table 1) illustrates, there are several potential uses of GenAI beyond simply “improving the readability and language” that authors could use to help them with their writing *which do not have these issues of concern*. For example, ChatGPT could be asked to suggest possible:

1. titles or section headings from a human-written abstract or section content
2. abstracts or paragraphs from human-written (and properly referenced where required) dot points (see Example 10)
3. outlines or idea prompts for a literature review or a section of the work.

Thus, a more detailed analysis could suggest a wider range of acceptable uses of GenAI in research writing, an issue that will be of interest in the support of higher degree by research (HDR) students.

2. Provide in the Appendix (p. T51), a compilation of prompts related to the components of the frameworks, together with use examples and critical commentary. These prompts and commentary are provided so that educators do not have to individually “recreate the wheel”, at least at a foundational level, and developing students’ digital literacy skills will entail teaching them about both prompt engineering, and the potential issues with GenAI responses to prompts that need to be considered.
3. Discuss briefly some of the challenges and issues around GenAI use by students (Section 4).
4. Present some ideas about what further research will be needed to achieve the desired goals mentioned above (Section 5).

2. Framework 1: A continuum model

As noted by Sutton and Taylor (2011), there is a tension in university education between on the one hand supporting the development of transferrable skills valued in the workforce, such as being able to work effectively in collaborative teams, and on the other hand maintaining academic integrity, that is, ensuring that each *individual* graduate has achieved the level of competence indicated by their conferred degree. An added tension in this mix is the need to support students’ learning and intellectual growth in a discipline, including around the completion of assessment items required to be completed individually, without undermining their capacity to become independent learners. Consequently, across many degree programs, students are typically assessed by a combination of individual and group work.

These observations are relevant to discussions around student use of GenAI when completing assignments. While much commentary subsequent to the release of ChatGPT focused on concerns that (many) students would simply use ChatGPT to do their work for them (see Section 1.1), other commentary has discussed the different ways that researchers were using ChatGPT to *support* their writing, with such commentary indicating that there were *differing levels* of such support. A clear and thorough overview of many of the ways researchers were found to be using GenAI tools to support their writing is given in, “[Can ChatGPT Write Your Next Scientific Paper?](#)” (McKee, January 3, 2023). In this post, McKee explains how researchers can potentially use ChatGPT for their benefit to:

1. Suggest rewrites of awkward passages
2. Summarise results⁹
3. Make suggestions / provide thought starters such as one might get from colleagues and friends on:
 - a. potential titles from abstracts
 - b. possible directions for future research
4. Help with science communication¹⁰:
 - a. suggest tweets from abstracts
 - b. explain inputted content to a 12-year old.

Box 1: Prompt engineering

The online version of the Stokel-Walker and Richard Van Noorden [news feature](#) is quite useful in providing an example of an editing prompt, the key features of which are to include:

1. Context:
 - a. Topic of manuscript
 - b. Section of manuscript
2. Style guidelines:
 - a. Minimise use of jargon
 - b. Grammar is correct
 - c. Use active voice
 - d. Use a clear sentence structure.

⁹ There are reports of using AI to generate TLDR (too long; didn’t read) summaries of papers and embed them in published articles. That is, to help determine if a cited text might be worth following up on, a TLDR pop up summary can be obtained by hovering one’s mouse pointer over the citation.

¹⁰ Observation: That ChatGPT can do this quite well poses a problem for science communication type assignments.

McKee further notes, though, several problematic aspects (some of which have been addressed by later developments in GenAI tools), and finishes the post with a discussion of ethical use issues. In addition, Chris Stokel-Walker and Richard Van Noorden (February 9, 2023) reported that researchers were using GenAI tools to [help edit manuscripts](#) (see Box 1 above), as well as brainstorm ideas. Furthermore, Ethan Mollick's (February 17, 2023) [class experiments](#) revealed that student use of ChatGPT to complete an assignment achieved the best results when the students took a "co-editing" approach. That is, the students worked *actively* and *collaboratively* rather than *passively* with the chatbot. Thus, the practice of students working collaboratively with a chatbot to complete assignment work raises similar questions around the boundaries between acceptable "help/support/collaboration" and unacceptable "collusion" as does the practice of students seeking support or advice from fellow students or others.

However, even outside of the use of GenAI, the boundary between an acceptable level of help/support with an assignment and unacceptable collusion is not always clear, and studies have shown, using scenarios, that different students and different academics "draw the line" in different places (see, e.g., Barrett & Cox, 2005; Sutton & Taylor, 2011; Velliariis, 2015). Even the correction by another of surface errors in writing seems to be deemed unacceptable by some academics

(see Tables 1 and 2 in McNally & Kooyman (2017)). Consequently, it is recommended that academics provide sample scenarios to help students understand where the boundary between acceptable and unacceptable support lies (e.g. Parkinson et al., 2022). To support discussions to that end in relation to AI/GenAI use, see [Figure 1](#) below and [Table 1](#) in the next section.

Late in the development of this paper, I discovered others who have had similar ideas. In relation to [Figure 1](#), Leon Furze (n.d.) has developed a less fine-grained five-level "[AI Assessment Scale: From no AI to full AI](#)" which describes the sorts of assessable things students can do at each level, but does not provide any explicit examples with prompts and critiques as will be presented in the Appendix. In addition, Liu and Bridgeman (June 8, 2023) have suggested an expanded six-level scale and a [two dimensional grid](#), where the two axes describe the level of human and level of AI contributions. This grid has the weakness of having an empty quadrant, namely low human contribution and low AI contribution, but does have the value of identifying that for educational purposes, it is necessary that assessment tasks lie in the top half of the grid. That is, it is necessary to have *high levels of human contribution with varying levels of AI contribution*. This two-dimensional idea is captured somewhat in [Table 1](#) below (Section 3.3) by having levels within each stage of the writing process.

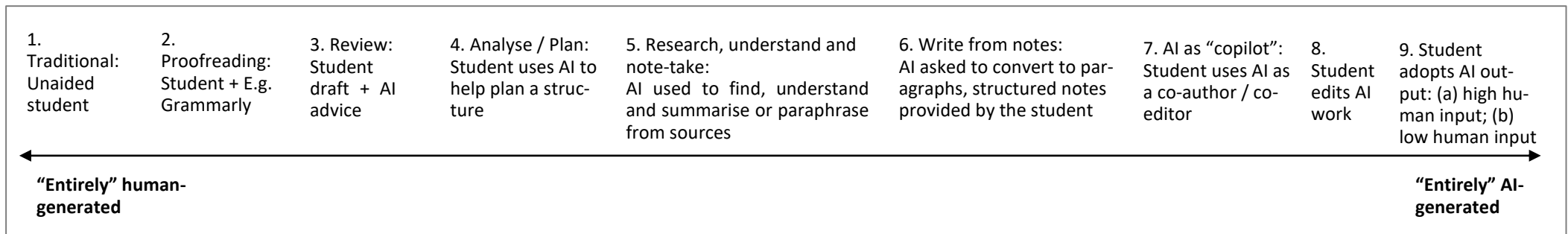


Figure 1. A possible model to guide thinking about the human-AI collaboration-collusion writing continuum.

The reason for the scare quotes around the "entireties" in [Figure 1](#) is that, as noted by an anonymous reviewer of this manuscript, level 9 has two sub-levels, each of which requires *some* human input. Level 9(a) requires a high level of

human input. That is, although an AI might do all the writing, this writing would be the outcome of a series of prompts by the human writer which provide feedback to the AI on how it should revise and improve successive drafts. For

an [example of this sub-level](#), see Approach 3 in Mollick (February 17, 2023). Level 9(b) would be the lowest level of human input where a student would simply copy and paste the assignment task provided by the lecturer into an AI, ask it to respond, and then submit the AI's response verbatim. In addition, even at level 1, some AI input is likely. For example, the use of Google Scholar to find references for an assignment relies on a computer algorithm to interpret what a query is after and then determine what the best sources might be for that query.

3. Framework 2: A stages of writing + continuum model

3.1. Rationale for Framework 2

Rather than categorising AI support with writing along a one-dimensional continuum, as was discussed in Section 2, some authors have thought about organising the sorts of support that are possible into uses at various stages of the writing process. For example, the human-AI interaction researcher, [Katy Ilonka Gero](#), has found that creative writers have been using AI tools as “a half-decent writing buddy” in the

1. Planning
2. Drafting
3. Revising

stages of writing, with the positive (and ethical) use of such support being for the writer to see any AI generated suggestions as being something the writer needs to improve on ([Gero, December 2, 2022](#)).¹¹ In the context of student academic writing, John Spencer (February 20, 2023), in “[The Future of Writing in a World of Artificial Intelligence #ChatGPT](#)”, provides an additional two earlier stages:

1. Initial conceptual understanding
2. Research

and suggests ways students could use, and document their use of, different levels of GenAI support in each of the stages.

Pooling these ideas together and adding an additional stage, “Developing a research question”, the framework presented in this section ([Table 1](#)) first breaks the writing process down into the following stages:

1. Developing a research question
2. Initial conceptual understanding
3. Research and note-taking
4. Organizing ideas and outlining
5. Writing
6. Editing and revision.

Then, within each stage, it indicates the sorts of tasks GenAI can provide help with, again with the goal of ordering the support from least to most intrusive.

Pedagogically-oriented commentary on each potential use, together with links to relevant resources and actual use examples, is then provided in the second column. The goal of this second column is to stimulate discussion, not necessarily to land on a definitive policy recommendation as much research is likely needed to determine what sorts of use at what year level / level of development are helpful or not. In this column, the links to use examples are provided because

¹¹ It is also interesting to note that Gero also explores writers' concerns about the possible negative influences of AI feedback and suggestions, such as “normativity”, “tokenization” and “stereotyping”.

learning how to effectively “prompt engineer” (see Sections 3.2 and 5.2) will also need to be an important pedagogical goal.

The third column is included as a suggestion for course materials; the expectation is that course coordinators will indicate in this column what uses are acceptable or not for a piece of assessment.

Since an important aspect of academic integrity is acknowledging the work of others, both ideas and expression, on which a piece of academic writing is built, part of the conversation academics need to be having with their students around the use of GenAI in academic writing is what use needs to be acknowledged (if any use is allowed for a particular task), and what is an acceptable form of acknowledgement. As a result of this observation, one column of Table 1 is dedicated to thoughts on how students might appropriately acknowledge the different components of the framework. The suggestions in this column have been heavily influenced by [University College London’s resources](#) and the [APA Style blog](#). See also the discussions in “[The Future of Writing in a World of Artificial Intelligence #ChatGPT](#)” by John Spencer (February 20, 2023), and “[My class required AI. Here’s what I’ve learned so far.](#)” (Mollick, February 17, 2023). Whether all levels of use should be acknowledged, especially at the brainstorming and research stage, will be a matter for lecturers to determine. However, a principle that may be useful for making such decisions is to ask the question: When do we need to discriminate between what is the student’s thinking and what is an AI’s? Lecturers might also want all GenAI use acknowledged so they can learn how students are using AI tools in their assignments.

Also regarding acknowledgement, to reinforce in students’ minds that they are and will be held accountable for what they write with the help of GenAI in both academia and their future careers,^{12,13} it may be useful to require students to state when submitting work where GenAI use was allowed, that they have:

reviewed and edited the content as needed and take full responsibility for the content of the assignment. (Adapted from Elsevier’s [Guide for Authors](#)).

3.2. Some notes on prompt engineering

To help readers appreciate the structure and characteristics of the prompts illustrated in the examples associated with Framework 2 given in the Appendix, this sub-section provides a brief overview of “prompt engineering”.

“Prompts” are the instructions human users give GenAI tools to elicit responses from the tools. Prompts differ from coding in the sense that there is no specific syntax or coding functions (other than that required by the English language), and so obtaining the “best” results from a GenAI tool is part art and part science, and may require an iterative process by the human user¹⁴. Thus, “*prompt engineering* is the process of creating and refining the input given to an AI tool to get better results” (Teubner et al., 2023, p. 98), and “*prompt engineers* interpret and translate tasks from human language into the expressions that elicit the best results from the AI” (Bradshaw, 2022 and Breithut, 2023, as cited in Teubner et al., 2023, p. 98) [italics in original].

¹² See also Munoz et al. (2023, p. 2).

¹³ These recent cases: “[A lawyer used ChatGPT and now has to answer for its bogus \[case\] citations](#)” (Davis, May 28, 2023), “[New York lawyers sanctioned for using fake ChatGPT cases in legal brief](#)” (Merken, June 26, 2023); and “[Publisher blacklists authors after preprint cites made-up studies](#)” (Retraction Watch, July 7, 2023) may provide salutary lessons to students about the importance of taking this responsibility seriously.

¹⁴ See for example, the [iterative examples](#) in Mollick (February 17, 2023) and the “Example for assignment 2” in the appendix of Mollick and Mollick, 2022).

Some key elements of a good starting prompt for writing purposes are to give the AI a role, the appropriate context, a task statement, and evaluative criteria for the desired outcome. For example:

| | |
|-----------|---|
| Role: | You are a human resource management (HRM) university student |
| Context: | tasked with compiling a 2000 word literature review on "pet-friendly workplaces". |
| Task: | Please provide a list of questions this review should address |
| Criteria: | and provide the list in a logical order. |

It is also important to *not* give too many tasks at once or the AI may get “confused”. For the above example, it would therefore be best to ask the following question with a follow-up prompt rather than include it in the initial prompt: “*What HRM theories would be useful to use in framing the discussion of the questions you have just provided?*” For an example of a more extensive list of criteria for a desired response, see Box 1 on page T35.

Links to some guides on prompt engineering, together with thoughts on needed research from the academic language and learning (ALL) perspective, are given in Section 5.2.

3.3. Details of Framework 2

Table 1. Uses of GenAI in academic writing, a possible stages of writing + continuum model.

| Research-Writing Stages | Comments | Acceptable (✓) / Unacceptable (✗) Use | Sample acknowledgement text |
|---|---|---------------------------------------|--|
| 1. Developing a research question | | | |
| <p>(a) Suggest research questions</p> <p>AI is used to suggest questions directly which can form components of the assignment or the main focus of the assignment.</p> | <p>Illustrations of this use are given in Example 1 and “Fostering AI literacy: A teaching practice reflection”, which gives an example of a process for refining potential PhD level research questions.</p> <p>Being able to ask good questions is a valuable skill for both researching and writing. If students use such AI-generated questions to develop their own skills in question generation, and look for other important questions as they start their research, then such support could be pedagogically useful. If, however, students simply use AI to do their thinking for them, or fall into the trap of “confirmation bias” when researching AI-generated questions, then such use could be pedagogically harmful. Exercises where students have to add to or refine AI-generated questions on a topic may help address the potential pitfalls.</p> | | <p>[Following the UCL guide:]</p> <p>Description of AI use</p> <p>ChatGPT was used to generate some possible questions for this assignment. The final question addressed is based on option 3, with adaptations being made as a result of what I learned from personal research on the topic. No other use of a generative AI was used in the production of this assignment.</p> <p>Reference:</p> <p>OpenAI, ChatGPT, 15 Feb 2023, https://chat.openai.com/APA Prompt: Suggest some possible research questions in relation to <topic / issue>.</p> <p>AI Response: ...</p> |

| | | | |
|--|--|--|---|
| <p>(b) Develop a research question</p> <p>A series of prompts are used to home in on a possible re-search question.</p> | <p>Example: "Using generative AI to develop your research questions" (Pretorius, January 24, 2023).</p> | | <p>[Similar to 1(a).]</p> |
| 2. Initial conceptual understanding | | | |
| <p>(a) Explain task terminology</p> <p>AI asked to explain the meaning of terms in the task description / marking rubric.</p> | <p>See Example 2.</p> <p>Although this use would not seem to require acknowledgement, asking students to include one may be useful to identify possible causes for groups of students heading in unexpected directions, and more generally, ways assignment tasks can be more clearly explained.</p> | | <p>ChatGPT was used to explain certain task requirements such as what constitutes a 'critical analysis'.</p> |
| <p>(b) Explain task expectations</p> <p>AI asked to explain expectations around the assignment task.</p> | <p>See Example 3.</p> <p>There is a risk here that the AI will not (be asked to) take into account course requirements / aims and objectives and so may give misleading advice. Students may need to be warned about risks of asking for clarification from an AI rather than the lecturer or a course tutor.</p> | | <p>ChatGPT was used to explain certain task requirements, such as what it means to "use a particular theoretical lens for analysis".</p> |
| <p>(c) Provide task background</p> <p>AI asked for background on key aspects of the topic.</p> | <p>Since large language models (LLMs) are known to make factual errors and make things up ("hallucinate"), all background found in this way should be "fact checked" using authoritative / peer-reviewed sources before being used in an assignment. And once "fact checked", the sources for the fact checking should be cited rather than the generative AI. However, use of the AI may still need to be acknowledged, and students should also be encouraged to consult their lecture notes and textbook!</p> | | <p>[If answers to questions provided by a GenAI tool <i>are</i> allowed, then "How to cite ChatGPT" (McAdoo, April 7, 2023) on the APA Style blog gives a possible approach with a concrete example.]</p> |
| 3. Research and note-taking | | | |
| <p>(a) Find sources</p> <p>An AI is used to help students get started with a literature review.</p> | <ul style="list-style-type: none"> • While ChatGPT is unable to reliably produce sources (it "hallucinates"), in some cases asking it to "provide a list of some of the leading scholars in the field of Z" can provide a useful starting point for more traditional searches. • Other AI tools do claim to be able to provide researchers with good quality literature review references (e.g. Elicit). However, since the algorithm used to produce such | | <p>[Following the UCL guide:]</p> <p>Acknowledgement:</p> <p>I acknowledge the use of Elicit (https://elicit.org/faq) to find and understand references for this assignment.</p> <p>Description of use of AI:</p> <p>...</p> |

| | | | |
|---|--|--|--|
| | <p>references is unknown, it is thus also unknown whether there is some possible bias in the references found, but the same issue is also present with Google Scholar.</p> | | |
| <p>(b) Explain source material Students use AI to help overcome the challenges of understanding text not written for students / non-experts.</p> | <ul style="list-style-type: none"> • One approach is to copy and paste difficult to understand text into ChatGPT's text box and ask it to, "Explain the following text more simply / at the level of a 12 year old." (See Example 5.) • This approach is also possible using the new, AI-powered Bing. See "AI in Your Web Browser is a GAME CHANGER Microsoft Edge" and "AI Feature in Edge - A Productivity Booster to Try Now!" for how it works. • Apart from ChatGPT itself, other AI tools to help students and researchers understand difficult content in research papers are also appearing. For example, with the SciSpace tool¹⁵ marketed as "Your AI Copilot", one can highlight terms / formulas / text in research papers and ask the AI for simpler explanations. Two short instructional videos showing how, and how well, the tool works, have been posted by Sparks (January 13, 2023) and Walker (December 14, 2022). See also: https://www.explainpaper.com/ | | <p>[If parts of such explanations are used in an assignment, they need to be paraphrased or quoted in the usual way, and following the advice in the APA Style blog, cited like the output from an algorithm. For example:]</p> <p>In-text citation: In relation to the question of ..., Bing Chat's (Microsoft & OpenAI, 2023) interpretation of <references> is that ... <now comes your discussion of the implications in relation to the wider assignment goals>. [Here, <references> are citations of the references Bing Chat cites.]</p> <p>Associated reference list entry: Microsoft & OpenAI. (2023). <i>Bing Chat</i> (March 14 version) [Internet search engine and large language model]. https://www.microsoft.com/en-us/edge/features/bing-chat?form=MT00D8</p> |
| <p>(c) Take notes from sources An AI is asked to paraphrase or summarise text.</p> | <p>Note that such capabilities are built into the AI-powered Bing's "Insights" function.</p> <p>While ChatGPT's capacity to paraphrase (Example 6) and summarise text could be useful in instructional sessions teaching students these note-taking strategies, there are risks that if students use the techniques in their assignment writing that they will not actually learn the material as well, and may be tempted to simply patch such paraphrases together rather than synthesise them.</p> <p>Summarising without first understanding also runs the risk of important limitations or nuances being missed (i.e. students getting an AI to summarise some text for them should be able to critically evaluate that summary).</p> | | <p>[Depends on how the paraphrased notes are used.]</p> |

¹⁵ The free version seems fairly limited in its capabilities though.

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| | Note also that anyone uploading materials to Generative AI tools (e.g. ChatPDF) should be aware of the possible copyright restrictions on the materials they upload, and note the licensing of academic journals may restrict this use. | | |
| <p>(d) Obtain answers to questions</p> <p>Students use AI as a research source.</p> | <p>While it might be a useful productivity hack for experts to ask a GenAI tool to produce a set of notes on a topic, it is highly problematic for students to do so. This difference arises because LLMs can make factual errors and make things up (“hallucinate”). While experts can “fact check” much AI-generated content using their personal knowledge base, students cannot, and may not, even if warned that they need to do so. One approach to addressing this issue is to treat generative AI content the way Wikipedia content currently is. That is, it is okay for getting started, but not okay to use in the final assignment as it cannot be considered as being “authoritative”.</p> <p>However, even for getting started, using GenAI may be problematic in that it may introduce easy to understand misconceptions which “stick better” in students’ minds.</p> | | <p>[Asking students to acknowledge using a GenAI tool to provide some background knowledge may help lecturers identify common weaknesses in students’ background knowledge that it would be pedagogically useful to address in class.]</p> <p>Acknowledgement:</p> <p>To help me get started with this assignment, <name of AI tool> was used to provide an overview of <name of topic>. This overview was used to guide my research and helped me to understand better some of the references I found, but no elements of this overview were used in my final assignment. All elements in my assignments which overlap with this overview come from the peer-reviewed sources I have cited.</p> |
| 4. Organizing ideas and outlining¹ | | | |
| <p>(a) Identify key themes</p> <p>An AI is asked to identify key themes from a set of notes which the student then uses to develop a framework for their assignment.</p> | See Example 7 . | | <p><Name of AI tool> was used to identify themes in the notes I had taken from the sources I had found. I then grouped and organised these themes into a logical order myself, and used or adapted some of the phrasing of the themes in my topic sentences.</p> <p>[<i>Question:</i> If a student quotes verbatim the textual description of a theme as provided by the AI tool, are they required to acknowledge that with the use of quotation marks and an in-text citation? What if the theme is just the AI tool parroting back from the notes provided by the student?]</p> |
| <p>(b) Suggest an outline</p> <p>An AI is asked to suggest a possible outline for a piece of writing which the student adopts and/or adapts.</p> | See Example 8 and Example 9 . | | <p><Name of AI tool> was used to provide an initial high-level outline for this assignment. The prompt used was, “...”, which produced the following output:</p> <p>...</p> <p>While much of this outline was used to structure my final assignment, several changes were made. These changes included</p> |

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| | <p>explain how they refined any outline provided by an AI and allocating marks to the level of thinking exhibited by the revisions.</p> <p>A possible issue with asking a GenAI tool to provide an outline for a topic is that ChatGPT generally provides this outline as a list of points to make, which may lead to confirmation bias (i.e. students will just look for evidence supporting the points to be made rather than being open to the possibility that the points are incomplete or possibly biased) if an outline in terms of questions is not asked for.</p> | | <p>adding paragraphs on A and B which my research revealed were additional issues, and some of the focus questions were altered to better meet the assignment requirements.</p> |
| 5. Writing | | | |
| <p>(a) Convert structured notes into paragraphs</p> <p>Student provides structured and cited notes to an AI and asks for the notes to be converted into properly cited paragraphs which the students adopts and/or adapts.</p> | <p>See Example 10.</p> | | <p>Acknowledgement:</p> <p>I acknowledge the use of ChatGPT (https://openai.com/blog/chatgpt) to help construct many of the paragraphs in this assignment.</p> <p>Description of use of AI:</p> <p>I did the required research and took structured and referenced notes from the sources I consulted and collected these notes under an ordered list of focus questions. I then used ChatGPT to convert these notes into draft essay paragraphs. An example of this conversion is as follows.</p> <p><u>Prompt:</u> Turn the following notes into an essay paragraph: <Notes in the form of Example 10.></p> <p>I reviewed and edited the results as needed to achieve overall flow in the essay and take full responsibility for the content of the essay.</p> |
| <p>(b) Transform or condense content</p> <p>An AI is asked to transform or condense student-written content. [See also 6(e).]</p> | <ul style="list-style-type: none"> Examples include suggesting possible: <ul style="list-style-type: none"> (i) titles for some writing or from an abstract (ii) abstracts given notes from the article (iii) social media content such as tweets from an abstract, or science communication text (“Explain to a 12 year old ...”) Another possibility is to ask an AI to “summarise” the text on an excessively wordy PowerPoint slide into “(three) bullet points” (Stratvert, February 2, 2023). | | <p><Vlog overview> (Overview generated by ChatGPT based on transcript, 2/4/23.)</p> |

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| | <ul style="list-style-type: none"> An AI could also be asked to create an overview from the transcript of a Vlog post. | | |
| <p>(c) Co-create content</p> <p>Student has a “conversation” with an AI about a topic, refining their question prompts based on their assessment of the AI’s responses, then identifies the best responses and compiles and edits these as needed. Any necessary fact-checking is completed by the student using “traditional” methods.</p> | <p>See a description of such an assignment and a discussion of how different sorts of prompt sequences led to results of considerable variation in quality: “My class required AI. Here’s what I’ve learned so far” (Mollick, February 17, 2023).</p> | | <p>See the post by Mollick opposite for how he required students to document their use of ChatGPT. This is a case where documentation of the <i>methods used</i> would be necessary.</p> |
| <p>(d) AI generates content</p> <p>Student adopts without change, a piece of writing generated by an AI in response to a prompt.</p> | <p>While one’s initial reaction might be that such use would never be acceptable, here are a few cases where it might be: See level 5(b) examples.</p> <p>In order to develop students’ critical thinking skills, and raise their awareness of the limitations of GenAI, students may be asked to “critically evaluate the response they get to a prompt put to an AI.” Evidently, the response they get has to be quoted.</p> <p>Occasionally I see students doing courses such as organisational behaviour and education where they have to discuss a case from their professional experience, but the students do not have any relevant professional experience to draw on. In such cases, students have to either make something up or find a case from the literature they can use. Now, another alternative might be to use a GenAI tool to invent a suitable case to analyse.</p> | | <p><i>Acknowledgement:</i></p> <p>As I have no professional experience as a ... to draw on for this assignment, ChatGPT was asked to generate a fictional case in relation to the assignment requirements. The prompt used was ... The output was used largely unchanged / a condensed version of this output has been included in section 2 of this report.</p> <hr/> <p>[<i>Question:</i> Should students have to paraphrase the GenAI’s discussion? If marks are allocated in relation to a clear etc. description of the case, should an AI-generated section not be marked and the remaining marks scaled up so students are neither advantaged nor disadvantaged by such use?]</p> <hr/> <p><i>In-text citation:</i></p> <p>2. Case description</p> <p>[The following case was created by ChatGPT (OpenAI, 2023).] <case description></p> |
| 6. Editing and revision | | | |
| <p>(a) Check and correct spelling and grammar errors</p> <p>Spell and grammar checks in a word processor or using AI.</p> | | | <p>[None required? Or:]</p> <p>AI was only used to correct spelling, grammatical, and punctuation errors. The prompt used with <name of AI tool> was: ...</p> |

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| <p>(b) Refine draft (low level) “Low level” refinement of writing using tools such as Grammarly, though generative AI can also be used for this task.</p> | | <p>The free version of Grammarly was used to correct grammatical and punctuation errors, and to make minor refinements to my draft text. I reviewed the results and take full responsibility for the content of the assignment.</p> |
| <p>(c) Give feedback on structure AI is asked for feedback regarding overall structure.</p> | <p>Here, AI is asked to generate a “reverse outline” and asked for feedback. See Example 16.</p> | <p>To help improve the structure of this assignment, <name of AI tool> was asked to provide a reverse outline of the assignment and asked to provide feedback on this outline. The prompt used was ... After reviewing the outline and feedback, the following revisions were made. ...</p> |
| <p>(d) Give feedback on / refine draft (high level) Higher level refinement of a student-written draft: e.g. re-order ideas for better flow; add suitable topic sentences; checks against criteria; re-write more succinctly so as to reduce the length by 250 words without losing any of the key ideas, ...</p> | <p>There is a risk with this approach that while the AI produced texts does read better, the revised text may in fact misrepresent or misinterpret the original intent in subtle ways (see Example 12, Example 13, Example 14 and Example 15). Students therefore need to be made aware of the need to carefully check any text produced in this way and should also be asked to acknowledge that they have done so. Careful acknowledgement of this use is needed as use of GenAI detection tools may flag such revised text as being AI written, which could lead to academic misconduct investigations as AI detection tools could not distinguish between revised and wholly written text.</p> <ul style="list-style-type: none"> • Regarding oral presentations, one can also: <ul style="list-style-type: none"> ○ Ask for suggestions for “better” slide designs. ○ Get basic feedback on your presentation skills. | <p><Name of AI tool> was used to revise paragraphs 3 and 5 to improve readability. An example prompt with output is as follows: ... The revised text was carefully checked to ensure it was still factually correct and accurately conveyed the intended meaning, with any issues manually addressed by myself. An example of a correction made is as follows. AI suggestion: ... Revised text: ...</p> |
| <p>(e) Condense content AI is asked to reduce student-written content to meet a word limit requirement.</p> | <p>Students commonly have problems keeping their assignments under the word limit. Especially when they are well over the word limit, a GenAI tool such as ChatGPT could help condense student content while still keeping the key elements in a very time efficient way. Any such output would need to be checked for loss of key points or changes of meaning. However, such use may undermine students’ capacities to be able to succinctly address topics.</p> | <p><Name of AI tool> was used to condense an initial draft written entirely by myself from X words down to Y words. The final assignment is Z words because I did some additional editing of the text produced by <name of AI tool>. The prompt used was: ...</p> |

4. Some challenges and issues around GenAI use by students

Fully resolving the challenges and issues to be discussed in this section will likely require a long-term research effort, and so no definitive recommendations will be made here (other than that I think the issues need to be investigated). However, the issues are raised here in the hope that they will be useful for further thinking and research in the area.

4.1. How might instructors go about deciding what is acceptable and unacceptable GenAI use by students?

The productivity enhancements achievable through the use of GenAI tools (e.g. Noy & Zhang, 2023) mean that future employers will expect students to be competent in their use, just as students are expected to be competent users of Microsoft Office products and where relevant, statistical and computer aided design software for example. This expectation is recognised by universities (e.g. [Dever, May 2, 2023](#)), and consequently, to decide what uses may or may not be acceptable, [Matt Miller \(December 17, 2022\)](#) developed the following questions to consider when making pedagogical decisions:

- a. Which of the levels¹⁶ would you consider cheating? [That is, which levels mean we cannot assess student disciplinary knowledge and competence, as opposed to their competence in using AI tools to support work in a discipline?]
- b. Which levels are relevant to our students' future?
- c. Which levels would you use in your work as a professional?

While these questions are a good starting point, care is probably needed with regards to questions (b) and (c). Such care may be required because novice-expert studies show that novices need to progress through a series of stages to become experts (e.g. [Persky & Robinson, 2017](#); Schunn & Nelson, 2009), and the same is likely also true in regards to the use of generative AIs to support research and writing (cf. the fact that while computer algebra systems (CAS) have been able to solve calculus problems for 30 or 40 years, maths students still have to learn how to solve calculus questions by hand, *for several very good reasons* [see for example, Buchberger, 1990], though CAS packages are used for more challenging project work.) Thus, careful thought and research will be needed to determine what uses of generative AI at what level of experience and expertise support rather than undermine students' intellectual *growth* and *growth* in competence in their discipline. As [Geher](#) (January 26, 2023) recalls one of his graduate school advisors saying, "one's ability to write and one's ability to think are, at the end of the day, largely one-and-the-same." Consequently, there is the risk that if GenAI tools do *too* much of the writing at *too* early a stage in a student's development of expertise in a discipline, then their capacity to thinking effectively in the discipline may be undermined. In thinking about how to best develop both students' academic and digital/AI literacies, the *Academic Skills Model* staged approach of Scaffolded → Supported → Supervised → Independent work (Charlton & Martin, 2018; Charlton et al., 2022) will also likely prove useful.

Regarding ALL educators' work with HDR students, acceptable use will be governed by respective Graduate School policies, which in turn will likely be influenced by the policies in this area of major scientific journal publishing houses. Thus, while ALL educators cannot be aware of every journal's policy, it seems likely that it will be useful to be aware of the policies of some of the major publishers. To that end, I note that in relation to the issue of the use of GenAI tools for the writing of scientific papers, the *Science* and *Nature* families of journals, and *Elsevier*, are all in agreement that GenAI *cannot* be a co-author of a paper ([Thorp, January 26, 2023](#); [Nature, January 24, 2023](#); [Elsevier, n.d.](#)). The main reason given for this decision is that an AI cannot be

¹⁶ Levels of AI support for academic writing. For an expanded version of what Miller is talking about, see [Figure 1](#) in [Section 2](#).

held accountable for the submitted work meeting all the expectations around originality and correctness expected of scientific publications, and accountability is an expectation of authorship.

Beyond the question of whether or not an AI is an acceptable co-author for a paper, there is some variation between the journals about whether *any* use is acceptable at all. The *Science* family of journals seems to take the most extreme approach, currently banning *any* use not approved by an editor. In their [Image and Text Integrity section](#) of their *Editorial Policies*, it is stated:

Artificial intelligence (AI). Text generated from AI, machine learning, or similar algorithmic tools *cannot be used* in papers published in Science journals, nor can the accompanying figures, images, or graphics be the products of such tools, without explicit permission from the editors. In addition, an AI program cannot be an author of a Science journal paper. A violation of this policy constitutes scientific misconduct. [Italics added.]

In contrast, the [Nature family of journals](#) and [Elsevier allow some sorts of acknowledged use](#):

Where authors use generative AI and AI-assisted technologies in the writing process, *these technologies should only be used to improve readability and language of the work*. Applying the technology should be done with human oversight and control and authors should carefully review and edit the result, because AI can generate authoritative-sounding output that can be incorrect,¹⁷ incomplete or biased. The authors are ultimately responsible and accountable for the contents of the work. [Italics added.]

4.2. How can unacceptable use be detected / policed / prevented?

The detection, policing and prevention of unauthorised AI use in the production of written assignments is a major issue, but a detailed discussion of this issue lies outside the scope of this paper. Nevertheless, for completeness I make a few observations below and direct the reader to some relevant references.

An immediate concern with *any* GenAI use is that if only lower levels of the human-AI writing continuum (see [Figure 1](#)) are allowed, how many students will be tempted to go *beyond* the allowed level? Is the best way to resist temptation to avoid it altogether? That is, perhaps the only workable possibilities that support the maintenance of academic integrity are to either ban all use or allow any use provided it is fully documented and acknowledged (and explain what sorts of use will not lead to good marks). Suggestions for preventing use (which are not necessarily unproblematic), include a [return to oral exams](#) (Dobson, April 19, 2023), and even a [return to hand-written essays](#) (Heid, December 29, 2022). An example of allowing full use is described by Ethan Mollick (February 17, 2023) in [“My class required AI. Here's what I've learned so far”](#). See also: [“3 ways to use ChatGPT to help students learn – and not cheat”](#) (Xie & Anderman, June 6, 2023) and [“ChatGPT is the push higher education needs to rethink assessment”](#) (McKenna et al., March 12, 2023).

Regarding policing/detection, while AI writing detectors have been and are being developed, these currently have a number of problematic features. For instance, there are numerous videos on YouTube which explain how to beat such detectors.¹⁸ Consequently, it appears as though such detectors are not likely to be particularly successful, and may only identify incidental misuse by students succumbing to temptation due to a pressing deadline and fear of failure. There are also concerns about these detectors incorrectly identifying as being AI written, heavily formulaic and

¹⁷ Note that “incorrectness” can arise not only when asking a GenAI for information, but also when asking a GenAI to improve the readability of text written by a human. See [Example 13](#).

¹⁸ I am not providing any examples of such videos as I do not wish to provide any direct recognition of such unethical behaviour.

“simple” writing by non-native speakers of English (see “[James Zou, et al, warn on the objectivity of AI detectors](#)” for an overview, and Liang et al. (2023) for the full preprint). The tools have also been reported to pick up AI translations of student work (“[International students and researchers concerned tools to detect AI-generated text may be inaccurate](#)”) and anecdotally, the use of Grammarly.¹⁹

Despite the above problems, a number of clues may help instructors intuit possible misuse for closer investigation. For example, if Turnitin is asked to assess reference lists and one or more references are not matched, this may indicate fabricated references and hence the use of a GenAI tool as ChatGPT is well-known to fabricate references. Nikki Usher (May 4, 2023) also tells of [identifying an AI written assignment](#) by the contradictory facts that the assignment looked like a last minute rush job whose “argument [was] only vaguely responsive to the prompt” but which lacked the usual grammatical errors and misspellings one would expect of something written at the last minute. Irrelevant examples and examples that appear to be fabricated, as was the case for a journalist who set himself [the task of writing a university essay on a topic about which he knew nothing in an hour using ChatGPT](#), are likely also other indicators to watch out for.²⁰

5. Discussion: Some ideas about needed research

In relation to the question of how to redesign teaching, learning and assessment in higher education in a world of GenAI tools, here are a few questions that I think will require detailed research when it comes to academic writing.

5.1. Pedagogical research

1. If students are allowed to use GenAI tools to help them refine and edit their work, and reduce content to get under word limits, will this reduce:
 - a. how much long-term learning students obtain from assignment work?
 - b. students’ capacity to fluently articulate *orally* their thinking in a discipline with clients, colleagues and others?
2. How well can students critically evaluate any content and suggested revisions by a GenAI tool?
 - a. In particular, how likely is it that students weak in English or understanding will be able to determine if more clearly written text accurately reflects their intended meaning or accurately reflects the source content?
 - b. How well can students distinguish between revised text that is clearer in the sense of improved grammar and flow, and clearer in the sense that the reasoning supporting a claim is fully explicated and concrete examples are used to illustrate abstractions? What prompts are effective for achieving these higher order goals, and how can we guide students about how to develop such prompts?
3. If students are simply told to “describe any AI use in the production of their assignments”:
 - a. How effectively can they do so?
 - b. What can we learn from this about what students find most helpful and/or what might undermine their intellectual growth as effective communicators?

¹⁹ As a result of Grammarly corrections reportedly being identified as “AI written” by Turnitin’s AI detection tool, at our institution we are consequently now recommending students keep an “unedited by AI” version of their assignment in case they are called in for a possible breach of academic integrity.

²⁰ The journalist at least used an interrogative approach to his use of ChatGPT, which was good, but did not do any fact checking and serious critique of what ChatGPT had provided him. Consequently, the journalist was marked down for including irrelevant examples and not clearly, directly addressing the question. One illustrative example also appeared to be made up.

4. What are the most effective ways ALL educators could utilise GenAI in workshops aimed at improving students' academic writing skills? Such uses might include learning how to:
 - a. paraphrase (see [Example 6](#))
 - b. create outlines (see [Example 8](#) and [Example 9](#))
 - c. synthesise source material (see [Example 10](#))
 - d. critique “drafts” created by ChatGPT on various topics
 - e. ethically use and acknowledge the use of AI, including in the professional world (see for example, Long & Magerko, 2020, pp. 6-7).
5. What are students' perspectives on how GenAI tools can help or hinder their learning and development as academic writers? Some early findings have been reported in the following articles:
 - a. [“Bot swot: Martin says using ChatGPT to write his university essay improved his learning”](#) (Cindy Xie, Lorien Chen, Alex Anyfantis, March 8, 2023).
 - b. [““Please do not assume the worst of us’: students know AI is here to stay and want unis to teach them how to use it”](#) (Danny Liu, Adam Bridgeman, & Cecilia Ka Yuk Chan, May 16, 2023).
 - c. [“Sydney and Hong Kong university students 'optimistic' about generative AI, use it to learn”](#) (Sally Brooks, June 10, 2023).

5.2. Prompt engineering

Given the need of human users of GenAI tools to be able to craft effective prompts, several guides on effective prompt engineering have been produced, with the following guides providing useful starting points:

1. [“GPT best practices”](#) (OpenAI's guide)
2. [“The ONE ChatGPT Prompt to Rule Them All”](#)
3. [“I Discovered The Perfect ChatGPT Prompt Formula”](#)
4. [“How to... use ChatGPT to boost your writing. The key to using generative AI successfully is prompt-crafting”](#)
5. [“6 ChatGPT Secrets to Transform Your Writing Overnight”](#).

However, these guides are mostly targeted at using GenAI tools effectively as a (co-)author. Consequently, there appears to be a need for research into how to use GenAI tools effectively as a writing tutor. One approach to using ChatGPT as a tutor that has been explored to some extent is using GPT-4 (ChatGPT plus) as a “Socratic tutor” (see [sample starting prompt](#)). However, such use seems to have been mostly explored in the domains of learning content (e.g. [Khan, April 24, 2023](#)) or [developing critical thinking](#) in relation to a topic, so how to use the approach to help students improve their writing appears to be an open question.

5.3. The roles of ALL educators in a GenAI world

Just as students will have to be able to explain to prospective employers why it is worth employing them rather than simply asking a GenAI tool to do the work, it seems likely that ALL educators in the future will have to do the same. A detailed discussion of this issue lies outside the scope of this paper, but here are a few questions that come to mind:

1. How critical is the “emotional work” done in one-to-one consultations, such as encouragement, for supporting student resilience and hence retention?
2. How important is it that unlike an AI, ALL educators do not just respond to the questions asked by students, but will also think about the questions they *should* be asking? For example, not just, “Is my writing clear and structured well?”, but also:
3. Have I answered the (implied) assignment question?

4. Have I suitably addressed *all* the assignment requirements? (Such as the use of appropriate theories from the course to support the analyses undertaken.)
5. Have I referenced correctly and does any text appear to be inadequately paraphrased?
6. Are the strategies I used to construct this assignment as effective as they could be? And if they are not, how can they be improved?

6. Conclusion

The key question going forward is, “How can educators help students develop their ‘AI literacy’ to prepare them for their future careers while at the same time not undermine their intellectual growth in a discipline and the development of their communication skills *independent* of AI support?”²¹ Or perhaps better still, “How can educators *leverage* AI tools to *more effectively* support students’ intellectual development and communication skills?” This paper aims to support these goals in three ways: (i) with a possible description of the human-AI writing continuum (Figure 1); with a stages of writing and level of AI support framework (Table 1); and (iii) the provision of prompt engineering examples with critical commentary (Appendix).

The human-AI writing continuum proposed in Figure 1 has been presented as a framework lecturers can use to guide their thinking and discussions with students about what level of AI use might be acceptable for a given assignment given the learning goals of the assignment. The aim of the continuum is to move discussions beyond the simplistic dichotomy of no AI use versus full AI use, to realise that there is a continuum in between.

The stages of writing and levels of AI support framework presented in Table 1 was also created to support a developmental approach by ALL educators to improving students’ AI literacy in relation to communication skills. It is hoped this framework will help educators develop targeted developmental training in relation to AI support for academic writing in a staged manner, and perhaps provide lecturers an even more detailed framework for indicating which AI uses are and are not permissible for a given assignment. Since appropriate acknowledgment of the use of GenAI tools is necessary to maintain academic integrity, and this too is a literacy that will need to be developed, this framework also presents possible ways to acknowledge the different sorts of AI use presented.

Finally, to reduce the amount of “reinventing the wheel” that will be needed by ALL educators when it comes to the issue of effective “prompt engineering” in relation to different types of GenAI use, an appendix giving many examples with critical commentary has been provided. It is hoped that these examples will provide a solid foundation for further refinement of prompt engineering in support of the development of students’ communication skills.

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²¹ Such as will be needed when communicating orally with clients, the public, colleagues and so on.

Appendix: Use examples with commentary

The following use examples illustrate aspects of prompt engineering and the capabilities of ChatGPT (GPT-3.5) in the period December 2022 to April 2023, together with commentary on potential²² issues users need to be aware of.

In the following examples, my commentary on ChatGPT's responses are either in separate cells labelled as "Author comments", or threaded throughout ChatGPT's responses in square brackets and a coloured font. Coloured fonts and various highlighting are also used in prompt and response cells to draw readers' attention to the structure of prompts or key features I wish to highlight or discuss.

Stage 1: Formulating research questions

Example 1. An approach to getting help brainstorming possible sub-questions for a topic.

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| Prompt to ChatGPT: | Generate ten research questions in relation to the claim that, "Graduate students bear as much responsibility as their mentors for ensuring they are well-guided through their degrees." |
| ChatGPT's response: | <ol style="list-style-type: none"> 1. How do graduate students and their mentors perceive their respective roles and responsibilities in the mentorship relationship? 2. What strategies do successful mentor-mentee pairs use to ensure that the mentee is well-guided through their degree program? 3. How do graduate students' expectations of their mentors' guidance compare with the actual level of guidance they receive? 4. In what ways do graduate students' needs for guidance change as they progress through their degree program? 5. How do cultural and personal differences between graduate students and their mentors impact the mentorship relationship and the mentee's sense of being well-guided? 6. To what extent do graduate students rely on their mentors for guidance, and how do they seek guidance from other sources when needed? 7. How do mentor-mentee pairs navigate conflicts or misunderstandings that arise in the mentorship relationship? 8. In what ways do graduate students' research interests and career goals influence their need for guidance from their mentors? 9. How do mentor-mentee pairs adapt their mentorship relationship as the mentee transitions from coursework to independent research? 10. What are the long-term effects of having a well-guided mentorship experience on graduate students' academic and professional development? |

See also [Fostering AI literacy: A teaching practice reflection](#) (Pretorius, 2023) for an example of a process for *refining* potential PhD level research questions.

Stage 2: Initial conceptual understanding

Example 2. Understanding terms in marking rubrics.

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| Prompt to ChatGPT: | When lecturers say that the best assignments will provide "insight" on the topic, what do they mean by that? |
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²² Note that as AI tools are continually being refined, and also do not always answer the same question in the same way, the issues identified in this appendix will not necessarily be replicable.

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| ChatGPT's response: | <p>When lecturers talk about assignments providing “insight” on a topic, they typically mean that the assignment should demonstrate a deep understanding of the subject matter. “Insight” implies a fresh, creative, or original perspective on the topic, rather than simply restating what has already been learned. The assignment should show that the student has a thorough grasp of the key concepts, theories, or arguments related to the topic and is able to apply that knowledge in a meaningful way.</p> <p>For example, an assignment that provides insight might include an original argument or analysis of a current issue, a new solution to a problem, or a creative application of a theoretical concept. The goal of such an assignment is to encourage students to go beyond rote learning and to demonstrate that they have truly internalized and can apply their knowledge in a meaningful way.</p> <p>In short, when a lecturer says that the best assignments will provide insight, they are looking for evidence of critical thinking, creativity, and depth of understanding.</p> |
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| Prompt to ChatGPT: | <p>What do academics mean when they say your essay should have a strong argument?</p> |
| ChatGPT's response: | <p>In academia, a strong argument is a well-supported and well-structured claim that effectively presents the writer's perspective on a particular topic. This means that the argument is clear and concise, and is backed up by evidence and examples that support the writer's position. A strong argument is also logical and coherent, and is presented in a way that is easy for the reader to follow and understand. In short, a strong argument is a compelling and persuasive case that effectively presents the writer's point of view on a given topic.</p> |

Example 3. Understanding assignment requirements.

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| Prompt to ChatGPT: | <p>What does it mean to analyse some aspect of politics, such as a particular government policy or the causes of some political event, using a particular “theoretical lens”? Please give a concrete example of how something could be analysed using two different theoretical lenses.</p> |
| ChatGPT's response: [Bolding added.] | <p>To analyze some aspect of politics using a particular theoretical lens means to examine it from the perspective of a particular theoretical framework or set of assumptions about how politics works. The choice of theoretical lens will shape the way in which one approaches the topic and the kinds of questions that are asked.</p> <p>For example, let's consider the issue of income inequality in the United States. One could analyze this issue using two different theoretical lenses, such as Marxism and liberal democracy.</p> <p>From a Marxist perspective, income inequality is seen as a natural outcome of the capitalist economic system, in which a small class of capitalists own and control the means of production, while the majority of workers are exploited and paid wages that are lower than the value of their labor. In this framework, the government policy solutions to address income inequality would be to redistribute wealth and resources from the rich to the poor, and to fundamentally change the structure of the economy to create a more equal distribution of power and resources.</p> <p>On the other hand, a liberal democratic perspective might view income inequality as a problem of unequal access to opportunity and resources, which can be addressed through policies such as progressive taxation, social safety nets, and education and training programs to help people increase their earning potential. In this framework, the government's role is to ensure equal opportunity for all, while preserving the basic tenets of a market-based economy.</p> |

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| | As you can see, the choice of theoretical lens can have a significant impact on how we understand and approach political issues, and can lead to different policy prescriptions and outcomes. |
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Example 4. Provision of overviews of background ideas.

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| Prompt to ChatGPT: | What are some of the key concepts in the theory of feminist institutionalism? |
| ChatGPT's response: | <p>Feminist institutionalism is a theoretical framework that seeks to understand how gender norms and power dynamics shape political institutions and policies. Some key concepts in feminist institutionalism include:</p> <ol style="list-style-type: none"> 1. Gendered rules: Feminist institutionalism argues that political institutions are not gender-neutral, but rather are shaped by gender norms and biases. Institutions may have formal rules or informal practices that advantage or disadvantage women and men in different ways. 2. Intersectionality: Feminist institutionalism emphasizes the intersectionality of gender with other social identities, such as race, class, sexuality, and ability. These intersecting identities create complex and varied experiences of institutional discrimination and exclusion. 3. Power and agency: Feminist institutionalism recognizes that women are not passive victims of gender discrimination, but rather have agency and power to resist, negotiate, and reshape institutional norms and practices. Feminist institutionalists therefore focus on how women's agency can be mobilized to challenge gender biases in institutions. 4. Policy outcomes: Feminist institutionalism also examines how gender biases in institutions shape policy outcomes. Institutions may produce policies that perpetuate gender inequalities, or may create policies that promote gender equity and empowerment. <p>Overall, feminist institutionalism provides a critical lens for analyzing political institutions and policies through a gendered and intersectional perspective, and offers insights into how institutional change can promote gender equity and justice.</p> |

Stage 3: Research and note-taking

Example 5. Help with understanding difficult texts.

The following is also possible to do with [Bing Chat](#).

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| Prompt to ChatGPT: | Explain the following paragraph in simpler terms: <p>"Intertextuality is another feature of postmodern aesthetics which seems to illustrate the erosion of 'originality' as a literary value. A novel like William Kennedy's <i>Legs</i> invokes both <i>The Great Gatsby</i> and <i>Gargantua</i> in its construction of the personality of the historical character Jack 'Legs' Diamond. Narrative perspective becomes dispersed and self-consciously unreliable, as in D M Thomas's <i>The White Hotel</i>. ... Perhaps the greatest 'liberating' feature of postmodern writing, however, has been the mixing of writings and intertextual referencing: the multivocal, heterogeneous and heteroglossic nature of postmodern writing has broadened the scope of contemporary fiction."</p> | |
| ChatGPT's response: [Highlighting added.] | <p>Intertextuality is a concept in postmodern literature that involves referencing other texts or works in a new piece of writing. It can involve characters, themes, or other elements from other works being incorporated into the new piece. This can lead to a sense that originality is not as important as it once was. An example of this is a novel that includes references to other works, such as "The Great Gatsby"</p> | <p><u>Author comment:</u> The final claim that it makes the writing "more diverse and inclusive" seems to go beyond what the original text claimed. Is this a valid extrapolation, and what does it even mean for such writing to be "more inclusive"?</p> |

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| | and "Gargantua," as a way to add depth to a character. Postmodern writing also often includes a mix of different writing styles and references to multiple texts, which can make the writing more diverse and inclusive. | |
| <i>Author comment:</i> The above response didn't address the "[n]arrative perspective becomes dispersed and self-consciously unreliable" part of the original text, so I queried further. | | |
| Prompt to ChatGPT: | Can you explain to me what the following means? "Narrative perspective becomes dispersed and self-consciously unreliable, as in D M Thomas's The White Hotel." | |
| ChatGPT's response: | The phrase "narrative perspective becomes dispersed and self-consciously unreliable" refers to a literary technique in which the point of view or perspective from which the story is told becomes fragmented or multiple, and the reader is aware that the information being presented may not be trustworthy. An example of this technique can be seen in the novel "The White Hotel" by D.M. Thomas. | |
| <i>Author comment:</i> As the above response still did not seem particularly clear, I queried further. Note how ChatGPT can "understand" that queries are a continuation of previous prompts in the conversation. | | |
| Prompt to ChatGPT: | Could you explain that again, but at the level of a 12 year old? | |
| ChatGPT's response: | Sure! When a book or story has a "dispersed and self-consciously unreliable" narrative perspective, it means that the way the story is told is broken up and not always trustworthy. The author wants the reader to know that they can't always believe what they are reading. This is like when a story is told by different people, and each person has their own version of the events, but none of them are completely true. An example of this is the book "The White Hotel" by D.M. Thomas. | |

Example 6. AI can help students learn how to paraphrase.

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| Prompt to ChatGPT: | Can you paraphrase the following text? "Without the background skills, however, learning to read is fraught with difficulties and dangers. For example, one of the prerequisites is to be able to hear language accurately enough to distinguish between similar sounds, such as 'bad' and 'dad' or 'pop' and 'pot'. Four-year-olds who are not good at these distinctions invariably turn into eight-year-olds who have serious difficulty with reading." |
| ChatGPT's response: | To be able to read well, it's important to have certain skills, such as being able to accurately hear and distinguish between similar sounds. If a child isn't good at this at four years old, they will likely struggle with reading when they're older. |

Stage 4: Organising ideas and outlining

Example 7. Identifying key themes in notes.

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| Prompt to ChatGPT: | <p>Consider the notes below in relation to a university-level business management assignment on whether diversity is a help or hindrance to group performance. Please identify the main themes that come out of these notes that the assignment should address.</p> <ul style="list-style-type: none"> • Mu & Gnyawali (2003) <ul style="list-style-type: none"> ○ Studied multimajor student groups ○ Such groups important because organizations expect graduates to be good team players and capable of working effectively in cross-functional teams. ○ Cognitive diversity can be beneficial <ul style="list-style-type: none"> – b/c reduces premature agreement and groupthink (Janis, 1982) |
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| | <ul style="list-style-type: none"> – thought to help the development of higher levels of skills and knowledge ○ Cognitive diversity can be a problem: <ul style="list-style-type: none"> – b/c cognitive differences can be hard to understand and coordinate (Colbeck et al., 2000) – b/c students may find it hard to accept other views of reality can have equal validity (Gallos, 1989) <ul style="list-style-type: none"> ▪ E.g. marketing students may prefer to focus on issues around customer likes and dislikes, while production engineers may prefer to focus on manufacturing efficiencies. – Tight time frames can also be a problem to coordinate many ideas. Students may prefer to come to a quick consensus rather than synthesise different views. ○ Found teams with higher levels of “team psychological safety” (TPS) tended to develop higher levels of synergistic knowledge. <ul style="list-style-type: none"> – TPS = group members believe group environment a safe one for bringing in diverse viewpoints. – BUT, Sethi et al. (2002) found that too much social cohesion can be a problem <ul style="list-style-type: none"> ▪ b/c candid debate needed for innovation, but highly cohesive groups suppress this in order to maintain relationships. ● Sethi et al. (2002) <ul style="list-style-type: none"> ○ Studied product development teams ○ Claimed managers believe that cross-functional diversity “provides the variety of perspectives and ideas essential to creative thinking.” <ul style="list-style-type: none"> – But they found that wasn’t necessarily the case. <ul style="list-style-type: none"> ▪ Found too many ideas causes information overload which makes it hard for teams to solve problems and come to decisions. ○ Found management encouragement for teams to be “venturesome” produced the most innovative results. ● Harrison et al. (2002) <ul style="list-style-type: none"> ○ Claimed that “Managing diverse workgroups is one of the most difficult and pressing challenges in modern organisations.” ○ Found maximising differences in knowledge, skills and abilities important for creating effective teams. <ul style="list-style-type: none"> – BUT Sethi et al. (2002) found problems (see below). ○ Reported that both deep and surface level diversity can negatively impact team performance <ul style="list-style-type: none"> ▪ b/c they can negatively impact team social cohesion (TSC) by evoking stereotypes, prejudices and biases (Fiske & Neuberg, 1990) and TSC was found to be important for team success ▪ “Surface” = differences in age, sex and ethnicity ▪ “Deep” = differences “values, attitudes, beliefs and personalities” ○ Found after sufficient collaboration, surface level differences become less crucial than personality difference and conflicts over organisational goals. ○ Found team social cohesion (TSC) important for success <ul style="list-style-type: none"> – BUT note Sethi et al. issue above. |
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| ChatGPT's response: | <p>The main themes that the assignment on whether diversity is a help or hindrance to group performance should address are as follows:</p> <ol style="list-style-type: none"> 1. The importance of cross-functional teams in organizations and the need for graduates to be good team players. 2. Cognitive diversity can be beneficial as it reduces premature agreement and groupthink, which can help develop higher levels of skills and knowledge. However, cognitive diversity can also be problematic, as cognitive differences can be hard to understand and coordinate, and students may find it hard to accept other views of reality as having equal validity. 3. The role of team psychological safety (TPS) in the development of higher levels of synergistic knowledge. TPS refers to group members believing that the group environment is a safe one for bringing in diverse viewpoints. 4. The negative impact of too much social cohesion on innovation, as highly cohesive groups may suppress candid debate to maintain relationships. 5. The importance of managing deep and surface level diversity to create effective teams, as maximizing differences in knowledge, skills, and abilities is essential. However, deep and surface level diversity can also negatively impact team social cohesion by evoking stereotypes, prejudices, and biases. 6. The importance of team social cohesion for success, but with the caveat that too much social cohesion can stifle innovation. 7. The need for sufficient collaboration to overcome surface-level differences, which become less crucial than personality differences and conflicts over organizational goals. |
| <p><i>Author comments:</i> A reasonable job, but missing the key idea of "management encouragement for teams to be 'venturesome' to produce the most innovative results".</p> <p>When asked to put the themes into a logical order for an essay, it largely stuck to the order above. While on the whole this order seems sensible, discussing the negative impact of social cohesion two paragraphs before introducing why it is desirable seems an odd choice, <i>indicating the need to use AI suggestions as a starting not end point.</i></p> | |

Example 8. Suggesting an outline.

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| Prompt to ChatGPT: | <p>Write an outline for an essay which addresses the claim that, "Graduate students bear as much responsibility as their mentors for ensuring they are well-guided through their degrees."</p> |
| ChatGPT's response: | <ol style="list-style-type: none"> I. Introduction <ol style="list-style-type: none"> A. Definition of the role of graduate students and mentors in the academic process B. Thesis statement: Graduate students and mentors both play a significant role in guiding and supporting the student's journey towards a successful completion of their degree. II. Background on the role of mentors in graduate education <ol style="list-style-type: none"> A. Definition of a mentor B. Responsibilities of a mentor towards graduate students C. Importance of mentor-mentee relationships in graduate education III. Graduate students' responsibilities in their education <ol style="list-style-type: none"> A. Taking initiative to seek guidance and support B. Staying proactive and engaged in their academic and research work C. Seeking feedback and advice from mentors and peers D. Making informed decisions about their education and career goals |

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| | <p>IV. Joint responsibility of graduate students and mentors</p> <ul style="list-style-type: none"> A. Communication and collaboration between students and mentors B. Shared goal of academic success and personal growth C. Importance of mutual respect, trust, and open dialogue <p>V. Challenges and solutions in balancing the responsibilities of graduate students and mentors</p> <ul style="list-style-type: none"> A. Time constraints and competing priorities B. Miscommunication and misunderstandings C. Addressing conflicts and disagreements D. Strategies for maintaining a productive and supportive mentor-mentee relationship <p>VI. Conclusion</p> <ul style="list-style-type: none"> A. Recap of the responsibilities of graduate students and mentors B. Emphasis on the importance of a collaborative and supportive relationship C. Final thoughts and call to action for both graduate students and mentors to prioritize their shared responsibility in ensuring a successful academic journey. |
| <p><i>Author comments:</i> There is a risk of confirmation bias for an outline of this sort if only evidence which supports the AI's "views" on the points to be made is sought.</p> <p>To address this potential issue, and consistent with my personal philosophy about how to develop effective plans, I recommend using the following alternative phrasing for the prompt.</p> | |
| Prompt to ChatGPT: | <p>Write an outline for an essay which addresses the claim that, "Graduate students bear as much responsibility as their mentors for ensuring they are well-guided through their degrees." Frame the outline in terms of questions to be addressed.</p> |
| ChatGPT's response (partial): | <p>...</p> <p>II. Background on the role of mentors in graduate education</p> <ul style="list-style-type: none"> A. What is a mentor and what are their responsibilities towards graduate students? B. How important are mentor-mentee relationships in graduate education? C. What impact can a mentor have on a graduate student's academic journey? <p>III. Graduate students' responsibilities in their education</p> <ul style="list-style-type: none"> A. What actions can graduate students take to seek guidance and support? B. How can graduate students stay proactive and engaged in their academic and research work? C. What role do feedback and advice from mentors and peers play in a graduate student's education? <p>...</p> |

Further comments on generating outlines:

In many cases, to get the best results from ChatGPT, a more detailed prompt with the following elements is required.

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| Tell ChatGPT what persona it is to take on: | You are an expert in molecular biology ... |
| Indicate the genre of the piece of writing: | ... writing a scientific review article for publication in an international research journal ... |

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| Precisely specify the topic of the review: | ... on the following topic: "The role of zinc toxicity as an antimicrobial response deployed by the innate immune system during infection: a possible source of novel therapeutics against infection to counter growing antimicrobial resistance." |
| And the expected key goals of the review: | The goal of the article is to motivate the review, review what is known about the topic, and identify directions for potentially fruitful new research directions. |
| State what you want it to do: | Suggest a possible outline for this review, framing the outline in terms of questions to address. |

Example 9. A combination of prompts may sometimes be needed, in this case to identify not only what questions to address, but also what theories might be employed to discuss the findings. Splitting up instructions like this is also necessary to avoid “confusing” the AI tool.

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| Prompt 1 to ChatGPT: | You are a human resource management (HRM) university student tasked with compiling a 2000 word literature review on "pet-friendly workplaces". Please provide a list of questions this review should address and provide the list in a logical order. |
| Prompt 2 to ChatGPT: | What HRM theories would be useful to use in framing the discussion of the questions you have just provided? |

Stage 5: Writing

Example 10. Conversion of structured notes into a paragraph. (Something similar could be used to generate a possible abstract for a research paper.)

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| <i>Author comment:</i> The structured notes below were simply copied and pasted from Word into the ChatGPT text box. While the indentation was lost, symbols for dot points were not and ChatGPT seemed to “understand” the hierarchical and grouped structure of the notes. | |
| Prompt to ChatGPT: | <p>Turn the following notes into an essay paragraph:</p> <ul style="list-style-type: none"> ▪ <u>Team Social Integration (TSI) or Cohesion</u> <ul style="list-style-type: none"> ▪ <i>Harrison et al. (2002)</i> <ul style="list-style-type: none"> ▪ Definition: <ul style="list-style-type: none"> ▪ “the extent to which the team is cohesive and team members enjoy team experiences, have positive social interactions within the group, and are satisfied with coworkers” (p. 1033). ▪ Found from a study of uni student teams that: <ul style="list-style-type: none"> ▪ TSI a strong predictor of team performance <ul style="list-style-type: none"> ○ BUT, demographic differences can trigger stereotypes which can negatively affect team social integration and hence team performance <ul style="list-style-type: none"> • BUT, frequent collaboration on tasks can reduce the impact of demographic differences ▪ <i>Sethi et al. (2002)</i> <ul style="list-style-type: none"> ▪ Studied new product development teams ▪ Found too much social cohesion can reduce innovativeness ▪ <u>because</u> team members worry more about maintaining relationships instead of having the robust debates needed for innovation. ▪ <i>Uzzi and Spiro (2005)</i> <ul style="list-style-type: none"> ▪ Studied Broadway musical teams ▪ Success criteria = box office and critical success ▪ Found: |

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| | <ul style="list-style-type: none"> ▪ less successful = completely new teams and teams which only included members who were comfortable working with each other. ▪ most successful = mixture of creative talents who had built up a comfortable working relationship with each other and new team members. | |
| <p>ChatGPT's response: [Highlighting added.]</p> | <p>Team social integration, also known as cohesion, is a crucial factor in determining the performance of teams, according to Harrison et al. (2002). Their definition of team social integration, which they describe as "the extent to which the team is cohesive and team members enjoy team experiences, have positive social interactions within the group, and are satisfied with coworkers" (p. 1033), highlights the importance of positive social interactions and team satisfaction in achieving high levels of team performance. However, Harrison et al. also found that demographic differences within teams can trigger stereotypes and negatively affect team social integration, reducing team performance. This negative impact can be mitigated by frequent collaboration on tasks, which can help reduce the impact of demographic differences. [On the other hand,] Sethi et al. (2002) found that too much social cohesion within teams can reduce innovativeness, as team members may be more focused on maintaining relationships than on engaging in the robust debates necessary for innovation. Uzzi and Spiro (2005) studied Broadway musical teams and found that the most successful teams were those that had a mixture of creative talents who had built up a comfortable working relationship with each other and new team members, while teams that were completely new or only included members who were comfortable working with each other were less successful.</p> | <p><i>Author comments:</i> This first yellow highlight goes beyond what the notes actually say: <i>anything produced by a generative AI tool needs to be checked!</i></p> <p>This second highlight illustrates that ChaGPT doesn't always link and signpost content as well as it could.</p> |
| <p><i>Author comment:</i> The part highlighted in green above indicates that ChatGPT did not understand the hypothesised link between the notes about Broadway musical teams and social cohesion. Consequently, I added some additional interpretation to the end of my notes and reran the prompt.</p> | | |
| <p>Prompt to ChatGPT:</p> | <p>Turn the following notes into an essay paragraph:</p> <p>...</p> <ul style="list-style-type: none"> ▪ <i>Uzzi and Spiro (2005)</i> <ul style="list-style-type: none"> ▪ Studied Broadway musical teams ▪ Success criteria = box office and critical success ▪ Found: <ul style="list-style-type: none"> ▪ less successful = completely new teams and teams which only included members who were comfortable working with each other. ▪ most successful = mixture of creative talents who had built up a comfortable working relationship with each other and new team members. <ul style="list-style-type: none"> ○ If one can assume that completely new teams will have lower than optimal levels of TSI, longstanding teams are likely to have an excessive amount of TSI, and mixed teams are somewhere in the middle, then these results are consistent with the view established from the Harrison et al. and Sethi et al. studies that | |

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| | a certain amount of TSI aids team performance but too much is counterproductive. |
| ChatGPT's response: [Coloured font added.] | ... Uzzi and Spiro (2005) studied Broadway musical teams and found that the most successful teams were those that included a mixture of creative talents who had built up a comfortable working relationship with each other and new team members, while the least successful teams were those that were completely new or only included members who were comfortable working with each other. If we assume that completely new teams will have lower than optimal levels of team social integration, longstanding teams are likely to have an excessive amount, and mixed teams are somewhere in the middle, then these results are consistent with the view established from the Harrison et al. and Sethi et al. studies that a certain amount of team social integration aids team performance, but too much can be counterproductive. |

Interestingly, ChatGPT did a far less impressive job when given a whole essay worth of structured notes and asked to write an essay using the notes. While it could discern what overall conclusion could be drawn from those notes, it organized each paragraph around single papers rather than different themes / sub-questions. Thus, topic sentences had the forms shown in the following example.

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| Prompt to ChatGPT: | Use the following notes to write an academic essay with an introduction, body and conclusion, correct in-text citations, and a reference list. The topic is on whether or not diversity is a help or hindrance for work group/team performance. <Copy of notes> |
| ChatGPT's response: | ... Mu and Gnyawali (2003) studied multimajor student groups and found that cognitive diversity can be beneficial in reducing premature agreement and groupthink (Janis, 1982) and in the development of higher levels of skills and knowledge. ... Sethi et al. (2002) studied product development teams and found that managers believe that cross-functional diversity "provides the variety of perspectives and ideas essential to creative thinking." ... |
| <i>Author comment:</i> Somewhat better paragraphs could be obtained by asking ChatGPT to revise what it had written according to a provided criterion as follows. | |
| Prompt to ChatGPT: | Can you improve the body paragraphs of the essay by starting with thematic topic sentences rather than the findings of individual studies? |
| ChatGPT's response: | ... Body Paragraph 2: The Impact of Diversity on Team Social Cohesion Team social cohesion (TSC) is an important factor in the success of work groups and teams. However, both deep and surface level diversity can negatively impact TSC, as Harrison et al. (2002) found. Surface level differences, such as differences in age, sex and ethnicity, and deep level differences, such as differences in values, attitudes, beliefs, and personalities, can evoke stereotypes, prejudices, and biases (Fiske & Neuberg, 1990). This can make it difficult for teams to work together effectively. Additionally, as Sethi et al. (2002) found, too many ideas can lead to information overload, making it hard for teams to solve problems and make decisions. Body Paragraph 3: The Importance of Team Psychological Safety and Sufficient Collaboration Team psychological safety (TPS) and sufficient collaboration are important factors in the success of work groups and teams. As Mu & Gnyawali (2003) found in their study of multimajor student groups, teams with higher levels of TPS tended to develop higher levels of synergistic knowledge. TPS is the belief that the group environment is a safe one for bringing in diverse viewpoints. However, as Sethi et al. (2002) found, too much social cohesion can be a problem, as it can suppress candid debate needed for innovation in order to maintain relationships. Additionally, as Harrison et |

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| | al. (2002) found, after sufficient collaboration, surface level differences become less crucial than personality differences and conflicts over organizational goals. ... |
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Stage 6: Editing and revision

Key elements of prompts:

1. Genre
2. Section / purpose
3. Desired features

Example 11. Check if meeting assessment requirements as indicated in a rubric.

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| <p>Prompt to ChatGPT:</p> | <p>Does the following paragraph include all the elements expected of argumentative writing in an academic context?</p> <p>"Regarding pay incentives and work performance, Miller and Estes (1961) have found that nine year old boys who were offered a monetary incentive performed significantly worse on a pattern matching exercise than boys who were not. In addition, Glucksberg (1962) found that undergraduates offered a monetary incentive took 50% longer on average to solve a creative problem-solving exercise than did undergraduates who were not offered an incentive; and Deci (1971) found that students who were not paid any money for writing headlines for their school newspaper continued to improve after instruction while those who were paid did not."</p> | <p>Prompt engineering advice:</p> <p>Note how:</p> <ol style="list-style-type: none"> 1. The context was given: "in an academic context". 2. ChatGPT wasn't just asked, "is there an argument", because it would respond, "yes", even if it has to <i>infer</i> what the argument might be. |
| <p>ChatGPT's response: [Coloured font added.]</p> | <p>The paragraph appears to include some of the elements expected of argumentative writing in an academic context, but it is missing some key components. In order to fully meet the expectations of argumentative writing in an academic context, the paragraph should include:</p> <ol style="list-style-type: none"> 1. A clear and concise thesis statement: This is a statement that presents the main argument or claim being made in the paragraph. The paragraph does not include a thesis statement, so it is not clear what the main argument or claim is. [Valid point.] 2. Supporting evidence: The paragraph includes some evidence in the form of findings from several studies, but it is important to ensure that this evidence is relevant and sufficient to support the argument being made. [Good, but generic advice.] 3. Analysis and interpretation of the evidence: It is not enough simply to present the evidence; it is important to also explain how the evidence supports the argument being made. This can include discussing the implications of the evidence and how it relates to other research on the topic. 4. A conclusion: The paragraph should [Not necessarily] include a conclusion that summarizes the main points made in the paragraph and restates the thesis in light of the evidence presented. 5. Citations: The paragraph includes citations for the studies mentioned, which is important for academic writing in order to give credit to the original authors and to allow readers to access the original sources. | |
| <p><i>Author comments</i></p> <p>In this case ChatGPT did quite a good job, but in general its feedback may be a mixture of valid and useful advice, as well as very generic and sometimes irrelevant or incorrect advice.</p> | | |

Example 12. Feedback can be both helpful and problematic in ways indicated in the example.

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| <p>Prompt to ChatGPT:</p> | <p>You are an experienced, university level writing tutor. Please provide feedback on the following paragraph from an organisational behaviour essay exploring the ways managers can positively influence employee motivation and performance.</p> <p>"Regarding pay incentives and work performance, Miller and Estes (1961) have found that nine year old boys who were offered a monetary incentive performed significantly worse on a pattern matching exercise than boys who were not. In addition, Glucksberg (1962) found that undergraduates offered a monetary incentive took 50% longer on average to solve a creative problem-solving exercise than did undergraduates who were not offered an incentive; and Deci (1971) found that students who were not paid any money for writing headlines for their school newspaper continued to improve after instruction while those who were paid did not."</p> |
| <p>ChatGPT's response:</p> | <p>Overall, the paragraph provides evidence from several studies that challenge the notion that pay incentives are always positively correlated with work performance. However, there are some issues with the paragraph that could be addressed to improve its clarity and coherence.</p> <ol style="list-style-type: none"> 1. Use proper citation format: The citations for the studies mentioned in the paragraph should be formatted according to the appropriate citation style (e.g., APA, MLA, etc.) to ensure proper academic referencing. [This comment is incorrect as correct APA formatting was used.] 2. Provide context for the studies: The paragraph mentions three studies, but it does not provide any context or background information about these studies, such as the sample size, methodology, and relevance to the topic of employee motivation and performance. Including this information would provide a better understanding of the studies and their implications. [This comment is only partially correct as the text did at least provide some information on the nature of participants ("nine year old boys", "undergraduates") and the nature of the study ("pattern matching exercise", "writing headlines").] 3. Use clear language: Some of the language used in the paragraph, such as "performed significantly worse," "50% longer on average," and "continued to improve after instruction," could be further clarified. It would be helpful to provide specific details on how the performance was measured, what the results indicate, and what the implications are for the topic being discussed. 4. Connect the studies to the main argument: The paragraph mentions studies that challenge the notion that pay incentives always lead to improved performance, but it does not explicitly connect these studies to the main argument of the essay, which is about ways managers can positively influence employee motivation and performance. It would be beneficial to clearly articulate how these studies are relevant to the topic and how they support the main argument of the essay. [This is a good point.] <p>Here's a revised version of the paragraph that addresses these issues:</p> <p>"Several studies have challenged the notion that pay incentives always lead to improved work performance. For example, Miller and Estes (1961) found that nine-year-old boys who were offered a monetary incentive performed significantly worse on a pattern matching exercise compared to boys who were not offered an incentive. Similarly, Glucksberg (1962) observed that undergraduates offered a monetary incentive took 50% longer on average to solve a creative problem-solving exercise compared to those who were not offered an incentive. Furthermore, Deci (1971) found that students who were not paid any money for writing headlines for their school newspaper continued to improve after instruction, while those who were paid did not. However, it is important to note that these studies may have limitations in terms of sample size, methodology, and generalizability to the workplace context. Nevertheless, these findings suggest that the relationship between pay incentives and work performance may not always be straightforward, and managers should carefully consider other factors that may influence employee motivation and performance."</p> |

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| | [It may be considered problematic that ChatGPT provides a rewrite. Is using this rewrite, perhaps modified, acceptable?] |
| <p><i>Author comment:</i> If such use is considered to be acceptable, students need to be made aware that the feedback so provided will not always be correct or useful, and so should only be taken as “things to think about / check”. This is fine for experts, but research may be needed to determine if problematic feedback undermines the confidence of weak students.</p> | |

Example 13. ChatGPT may not check for issues it is not explicitly asked to check.

On 27 May, 2023, I gave the following prompt to ChatGPT:

The text I will give below is part of a larger article on the ways that ChatGPT could be used to help academic writers improve the quality of their academic writing. It specifically occurs in a section with the heading, “ChatGPT’s limitations in editing”. Please provide guidance on how the text can be improved.
<Text for feedback.>

The response to this prompt was *not* to provide guidance, but rather was simply a rewrite of the text with the following message appended:

Note: The revised text incorporates some minor changes for clarity and cohesion, while retaining the core message of the original text. However, a few parts require additional context or clarification in order to provide a more accurate revision.

I then asked ChatGPT: “Please do not simply rewrite the passage, but tell me things I need to think about to produce a better version myself,” to which it provided generic advice, *none of which addressed the core problem with the passage*, and that was *it didn’t stay on topic*. Consequently, I then prompted ChatGPT with, ‘Please identify any aspects of the passage that stray from the topic implied by the section heading, which was, “ChatGPT’s limitations in editing”’, to which it *then* gave a thorough explanation of the various ways the text did not stay on topic.

Thus, this example illustrates that ChatGPT will not necessarily provide the guidance a writer needs if the writer does not ask it the right questions.

Example 14. Suggested revisions need to be checked for the introduction of misconceptions.

In the following example, while the response is more readable, it introduces a misconception. Nevertheless, the response could still help the writer come up with an improved version which is correct.

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| Prompt to ChatGPT: | <p>How can I make the following sentence easier to read without losing any of its elements?</p> <p>"To achieve the best sensitivity and specificity, uniform fat suppression, minimal artifacts, and high spatial and temporal resolutions are all important in breast DCE-MRI to allow accurate measurement of dynamic contrast enhancement (6)."</p> | <p><i>Prompt engineering advice:</i></p> <p>“Without losing any of its elements” was included in the prompt as simply asking for something to be made “easier to read” may result in some elements or technical language being dropped.</p> |
| ChatGPT’s response: | <p>Accurate measurement of dynamic contrast enhancement in breast DCE-MRI requires achieving the best sensitivity and specificity, uniform fat suppression, minimal artifacts, and high spatial and temporal resolutions (6).</p> | |
| <p><i>Author comment:</i> This revision implies that “uniform fat suppression, minimal artifacts, and high spatial and temporal resolutions” are things to achieve <i>in addition to</i> achieving “the best sensitivity and specificity”. However, they are not <i>additional things to achieve</i>, but rather <i>how</i> the best sensitivity and specificity is obtained. Nevertheless, it is relatively easy to correct the suggested revision:</p> | | |

“Accurate measurement of dynamic contrast enhancement in breast DCE-MRI requires achieving the best sensitivity and specificity **through** uniform fat suppression, minimal artifact **generation**, and high spatial and temporal resolutions (6).”

Example 15. Improving flow in a paragraph.

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| <p>Prompt to ChatGPT:</p> | <p>The following paragraph from a chemical engineering research paper is meant to explain how a rough surface was added to a pristine quartz sand filter. It is the opening paragraph of a section with the heading, "3.1 Coating Mechanism". Please suggest how it can be improved while still keeping it suitable for a chemical engineering journal. Explain any changes you make. "Dopamine hydrochloride can react with the Tris-buffer solution to form polydopamine (PDA) particles. PDA is rich in active groups (–OH, –NH₂), making it a versatile platform for secondary reactions [29], especially the formation of ligands with metal ions that can generate a nuclear/shell structure of PDA/metal oxide [30]. PDA particles react with ZnO and with the hydroxyl groups on the surface by a condensation reaction. As a result, the ZnO particles are coated on the surface of the quartz sand filter, and the roughness increases."</p> | <p><i>Prompt engineering advice:</i> Note how the prompt provides:</p> <ol style="list-style-type: none"> 1. Context: <ol style="list-style-type: none"> a. Genre the excerpt is from b. Title and purpose of section 2. Style guidelines: <ol style="list-style-type: none"> a. “Improved while keeping it still suitable for a chemical engineering journal”. b. Might have specified things like “improve flow”. |
| <p>ChatGPT’s response:</p> | <p>Here's a possible improved version of the paragraph:</p> <p>"The addition of a rough surface to a pristine quartz sand filter was achieved through a coating process that involved the use of polydopamine (PDA) particles. Specifically, dopamine hydrochloride was reacted with a Tris-buffer solution to form PDA particles rich in active groups, such as –OH and –NH₂. PDA particles were then used to react with ZnO particles via a condensation reaction that occurred through the hydroxyl groups on the surface. This resulted in the formation of a nuclear/shell structure of PDA/metal oxide on the surface of the quartz sand filter, leading to an increase in surface roughness."</p> <p>Explanation of changes:</p> <ul style="list-style-type: none"> • The opening sentence was revised to clarify the main objective of the section (i.e., explaining the coating mechanism). [Yes, much better now.] • The subsequent sentences were reordered to provide a clearer and more concise flow of information. [Yes, the changes altered a sequence of facts to a sequence of steps for achieving the desired goal.] • Unnecessary citations were removed [This is NOT acceptable!] and the reference to the nuclear/shell structure was rephrased to improve clarity. • The language was simplified and technical jargon was defined (e.g., "condensation reaction"). [Not clear that it did either of those things. Clarity was improved by linking the steps to describe the process by which the desired goal was achieved, rather than simply giving background on the reactions and processes that were used.] | |
| <p><i>Author comment:</i> While the revised paragraph is easier to read, it is critical that authors check that ChatGPT has not introduced any misconceptions with the revisions and that the rewrite is still technically correct.</p> | | |

Example 16. Feedback on overall structure.

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| Prompt to ChatGPT: | <p>Please provide a reverse outline in terms of the focus question of each paragraph for the following essay. Please identify any paragraphs which have an unclear focus, unclear topic sentence, or appears to be ununified.</p> <p>"<Copy of diversity and group performance essay.>"</p> | |
| ChatGPT's response: | <p>Here is a reverse outline with a focus question for each paragraph:</p> <p>I. Introduction</p> <ul style="list-style-type: none"> • What is the essay about, and what is its focus question? <p>II. The importance of cognitive diversity</p> <ul style="list-style-type: none"> • What is cognitive diversity? • Why is cognitive diversity important for high group performance? • How can cognitive diversity hinder group performance? [This question was actually addressed across two separate paragraphs.] <p>III. Challenges of diversity in group performance</p> <ul style="list-style-type: none"> • What are the other types of diversity that can pose significant challenges to high group performance? • How can surface-level differences negatively impact team social cohesion? • How can deep-level differences negatively impact team social cohesion? <p>IV. Maximizing positive impacts and minimizing negative impacts of group diversity</p> <ul style="list-style-type: none"> • What are the things that groups and their managers can do to maximize potential positives and minimize potential negatives? • What is the relationship between team social cohesion and team psychological safety? • Why is excessive team social cohesion undesirable? <p>V. Conclusion</p> <ul style="list-style-type: none"> • What is the main point of the essay? <p>The essay appears to have a clear focus question for each paragraph, and the focus is unified and coherent throughout the essay.</p> <p>However, paragraph II could be improved by providing a clearer topic sentence that more explicitly states the focus question.</p> <p>Additionally, paragraph IV could be clearer in terms of how exactly group managers can foster team psychological safety and team social cohesion.</p> | <p><i>Author comments:</i></p> <ul style="list-style-type: none"> • A reasonable job, but the essay actually had 8 paragraphs not 5 (5 is a common format for essays in US education). • ChatGPT also has different ideas about how to outline than I do, and so its outline is a hybrid of the way it likes to outline and the way I requested. <ul style="list-style-type: none"> • I disagree with this comment. • This is a valid point. |

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