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The use of cognitive reconstruction strategies with self-assessment (CRSA) in writing AI-based scientific papers in Indonesian language education learning

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ABSTRACT

The ability to recognize, appreciate, and connect different elements to resolve different issues is important for cognitive development and acquiring the different dimensions of the Indonesian language. Thus, it is imperative to study different cognitive approaches in understanding different and diverse scientific documents, particularly through the AI-based Cognitive Reconstruction Self-Assessment (CRSA) tool. This study, in the sphere of Indonesian Language Education, aims to study the degree to which the integration of chatbot with CRSA, improves the comprehension of students. The study found the cognitive scaffolding influenced by artificial intelligence promotes reading, understanding concepts, and better pedagogical interventions. This, in addition to helping students understand the structure of scientific writing, improves critical thinking. Moreover, the CRSA framework offers the opportunity to better organize, refine and improve the personalization of educational processes. The ability of artificial intelligence to personalize educational processes is paramount. Overall, the combination of CRSA and AI will inevitably help meet the contemporary educational challenges, particularly personalization and flexibility, and improve the practice of teaching.

Keywords: Cognitive, Artificial Intelligence (AI), self-assessment

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INTRODUCTION

The most recent breakthroughs in technology, most notably the development of Artificial Intelligence (AI), profoundly influence the manner in which individuals conduct themselves and interact in all facets of life. In the development of AI, the educational sector has also witnessed its growing prominence. It has become crucial to understand the evolving dynamically developing relationship between students and AI as it has become a highly valued center of scholarly inquiry. In line with the development of technology for the facilitation of the teaching of language, AI has also found its use in the facilitation of the teaching of the Indonesian language, especially in the teaching of students' scientific writing. In the process of AI evaluation and re-construction of students' scientific papers, students are provided with feedback on writing, arguing and grammatical errors in the structure of the paper in a more timely and comprehensive manner. Of many chatbots that AI offers, the ones that seem to peak the interest of professionals in academia and the teaching profession in the writing of scientific papers are Chat GPT, Gemini and Perplexity. The use of AI technology has also spread to the teaching of the Indonesian language. The AI-based application of Chat GPT has been employed to facilitate the writing process of students as it enables them to write drafts more rapidly and with greater ease. It has the potential to assist students in developing their concepts, and finding citations, and, in some cases, writing entire sections of research articles without having to understand what research involves and what the writing process is supposed to include. While ChatGPT has the potential to benefit students in the short-term, there are significant negative consequences related to its use in post-secondary education. The primary concern relates to the ethical use of artificial intelligence when it comes to constructing written assignments. Studies have shown that there is a looming threat to the delineation of human authored versus machine authored in the context of university assignments, presentations, and scholarly

publications. Overreliance on ChatGPT diminishes the need for students to engage in critical thinking, and deep contextual analysis, and writing that meets the criteria of scholarly research (Guleria et al., 2023). Furthermore, the impact that ChatGPT will have on the academic honesty of students is a significant concern. Students may use the writing assistant to complete their tasks quickly in an unethical way, i.e., using ALT to answer prompts and to create unabashedly plagiarized work. Also, in this sense, ChatGPT is more than a means to an end, it is a shortcut that takes away the chances students have to exercise their writing abilities in a way that is constructive and critical (Arochma et al., 2023).

ChatGPT has been designed to improve the process of retrieving information and streamlining the writing process. However, over-reliance on this tool decreases the students' ability to develop arguments and to analyze and synthesize findings Post-Modernism. In addition, the paradox of ChatGPT is that although it provides access to information, its use may weaken students' ability to analyze and critically evaluate the information, which is the essence of modern pedagogy (Putri & Khasanah, 2023). The lack of strong understanding, as well as the ability to integrate and process information at the cognitive level, may lead to adverse consequences on the students' academic skills. In addition, the ability to develop scientific texts is not solely determined by the ability to write grammatically correct sentences; it also involves students' capacities to critique and evaluate existing theories and articulate new ideas and arguments. Therefore, ChatGPT may, uncritically and without cognitive divestment, lead students into a cycle of shallow thinking, which is the opposite of the higher thinking that is expected and required in academic writing.

Utilizing ChatGPT as part of a student's learning process can be of assistance in gaining comprehension of formatting and structure of scientific writing and development of ability to articulate thoughts and information in an ordered manner. However, it does take a degree of management and control by the lecturers and teachers to make sure students do not overly depend on the AI technology and instead continue to cultivate the necessary skills in order to prepare and develop quality scientific papers. This illustrates the importance of the more balanced and strategically planned efforts made to better utilize the AI. Teachers and lecturers are required to find a way to teach students to ethically utilize these technologies while also balancing their instruction with approaches and techniques that develop their students' skills in the areas of higher order thinking, cognitive and analytical skills. This is inclusive of the support of, and in place of, the need for, the encouragement of thinking out of the box in process and strategies of scientific writing This is the basis of the importance of the development of critical thinking as a large part of the students' cognitive flexibility of learning the Indonesian language. It includes the ability to recognize, assess, and manipulate the information in the context of problem solving, which is a core skill in today's education (Facione, 2015) This research uses the AI-enabled Cumulative Reconstruction Self-Assessment (CRSA) method to explore cognitive strategies for understanding scientific papers. This qualitative case study focuses on the Indonesian Language Education course and examines how CRSA, paired with chatbot integration, assists students in the process of understanding, matching feedback, and improving higher-order thinking.

Research shows scaffolding augmented by AI provides better readability, better conceptual understanding, and quicker and better feedback from teachers. These all go in line with AI augmented educational/learning environments (Holmes et al. 2019). This develops better understanding and writing skills in the sciences and bolsters students' capacity to think critically. The strategy CRSA (SRSA) also allows the process of learning to be tailored and streamlined, resonating with literature on the positive influence of AI on the adaptive and learner-centerd paradigms (Luckin, 2018). All things considered, AI and CRSA integration is likely to bring forth the desired adaptability and customization and address the plethora of modern educational challenges/crisis and is an excellent precursor to more advancements in learning.

Said method of evaluative reconstruction in the context focuses on students going through and evaluating and analyzing scientific texts, and makes students go over their writing again. AI aids in this process of self evaluation by providing an analysis that is more objective, which is more likely to guide students in accurately identifying the strengths and weaknesses of their job. Such feedback allows students to better grasp the scientific ideas in the work.

Cognitive Strategy AI technology improvement in students' critical thinking is undeniable. Through this approach, students gain understanding passively and are actively involved in reconstructing and evaluating scientific texts. Thus, this study aims to identify the extent to which

cognitive strategies, the role of AI, and innovative AI-based models incorporating evaluative reconstruction methods can enhance students' understanding and writing skills in scientific papers within Indonesian Language Education courses.

The ability to think critically is crucial for the cognitive development of students, enabling them to adapt to the rapid pace of modern times. Critical thinking ability itself is a cognitive process in analyzing problems faced systematically and specifically, carefully and thoroughly. Critical thinking skills are also the ability to identify and review information to plan ways to solve problems (M. Azizah et al., 2018). The explanation agrees with the study that critical thinking skills can be measured through the following indicators: can formulate the main problem, can manage existing facts to solve a problem, can make arguments logically, relevant, and accurate, can make problem-solving strategies with several alternatives, and can consider the risks of a decision. Modern education emphasizes the need to develop critical thinking as this is what enhances the learning experience of students and the pedagogical approach to be adopted to ensure students are constructively and critically engaged in the learning experience. The Innovative pedagogical approaches adopted is what enhances the learning experience and optimizes the development of critical thinking and the engagement and motivation in learning.

This potential is backed by research. The combination of AI and curricula focused on critical thinking facilitates students in the development of arguments, evidence evaluation, and decision making (Salido et al., 2025). Generative AI is instrumental in enhancing higher order thinking, and this includes problem-solving, decision making, and the ability to think creatively (Song et al., 2025). Also, the development of AI based adaptive learning systems that personalize critical thinking based activities optimizes the engagement and learning outcomes (Correia et al., 2025). On the contrary, over dependence on AI is a drawback due to cognitive offloading, where the thinking process is contracted to AI, and this process is a barrier to reflective, deep thinking (Gerlich et al., 2025). AI based interaction in the learning of languages is interactive and can replicate a learning experience that includes Socratic questioning and aids in fostering metacognitive awareness which is a robust way of enhancing critical thinking of students (Darwin, 2024).

Some examples of poor models of teaching are ones in which the intended goal of enhancing the students' thinking capacity – in particular their ability to think critically – is not achieved. Most if not all teaching models involve some aspect of technology. With the advent of digital technology and more recently, the ability to learn through the use of Artificial Intelligence (AI), the ability to learn through the use of a technology that is designed to facilitate a particular cognitive process. The use of technology that provides instantaneous access to information can enhance the speed of learning, but, in doing so, it can jeopardize the quality of the social learning, the primary goal of Constructivist Learning (Vygotsky, 1978; Latifah, 2024). Social learning is a type of learning that occurs when students learn from one another. AI technology can support the personalization of learning, through adapting to the learners' specific needs, decreasing the need for teacher intervention, and providing increased opportunities to learn inclusively. There is a solid basis of ethics that underpins the use of AI technology in writing and that the use of AI technology will be monitored to ensure that it is supported and used in a sustainable manner, and will also take into account the need for a balanced approach in relation to the role of the teacher. Cognitive and metacognitive strategies help to overcome writing difficulties through instruction. These strategies help learners self-organize their understanding of the subject matter and help improve the content and quality of their writing. As noted in Nückles et al., 2009; Pitenoee et al., 2017; Maftoon, 2012; S. Azizah & Soraya, 2023, apart from skills in various languages, some cognitive and metacognitive methods show that learners can articulate and structure their thoughts coherently. Azizah & Soraya, 2023 has stated that in learning the Indonesian language, interactions affect the ability of learners to communicate their ideas logically. Here, teachers can organize group discussions of the texts that have been read so that they can articulate their ideas, build their understanding, and enhance their abilities to think critically. In cognitive strategy, the interaction in learning Indonesian as a Foreign Language using AI is to instruct students to communicate with a chatbot. For the Active part, teachers can also form small groups to discuss the research articles they have read. In this case, students are required to converse with each other.

Moreover, give opinions so that students build new understanding collaboratively. In this way, social interaction becomes a tool to develop knowledge and critical thinking skills. Interactive learning can boost students' interest in the learning process by cultivating students' self-assurance in articulating

their views (Raztiani & Permana, 2019). Artificial Intelligence can help students studying Indonesian language education comprehend difficult texts as it offers recommendations or explanations related to the construction and semantics of the sentences. The use of this technology advocates learning process and consolidates the mastery of the concepts acquired.

In higher education, the comprehension and retention of information are derived from the use of cognitive strategies. With the available evidence, it is important to configure how students demonstrate their understanding of digital information. The use and employment of digital information are demonstrated by students utilizing services such as Google Scholar and Google (search engines), yet students have poor understanding of how to use academic databases such as Springer, Elsevier, Scopus, ScienceDirect, ResearchGate, and Garuda. Students also use AIs (like ChatGPT) to complete their assignments, but students have high risk to just rely on the result produced by AIs (Lestariani et al., 2023). There are many elements beond cognitive strategies that influence the use of these strategies. Students' intrinsic motivation is important as it promotes the use of these strategies, and cognitive strategies require students to have prior knowledge to assimilate and accommodate the new information to their cognitive structure, and technology in the form of computer-based learning, and artificial intelligence can be used to personalize learning by providing interactive and adaptive learning resources, and students should have metacognitive awareness because, without the ability to self regulate their cognitive process (Veenman et al., 2006; Clark et al., 2016), the use of the cognitive strategies will be ineffective.

Problem-based, collaborative, and active learning techniques emphasize different components of underlying cognitive strategies. While self-assessment skills are primarily developed through the feedback of the educator, the interactions that take place among learners also help through the educator sharing and guidance. Students can, for example, request feedback from a peer after a writing assignment in order to fully and equally utilize the experience and insights of the peer. Such collaboration and feedback are essential to fostering a deeper understanding and reinforcing a more positive learning culture (Black et al., 2003; Jiwandani et al, 2021). Students increase the range of their understanding of concepts through the various strategies of learning that they use,. The cognitive strategies in learning that are used in conjtenction with various digital media and other learning technologies help to optimize learning. Adaptive learning technologies are an example of flexible learning where learners can make progress using self-learning strategies and learning methods. This flexibility of learning and methods is designed to be used by individual learners (Aleven & Koedinger, 2002). Furthermore, the innovative technologies of AI that are now being used for evaluative feedback also help to increase the effectiveness and efficiency of writing in a way that is new and different to the previous methods of feedback.

METHOD

This study uses a qualitative case study methodology. It investigates the unique experiences of students regarding cognitive strategies and AI technology while processing scientific papers. The Basic Personality Development students at the State University of Malang served as the case study. The researcher conducted in-depth interviews to collect data pertaining to the students' perspectives on their comprehension of scientific texts prior to and post AI intervention and also how AI assisted them in organizing and reconstructing information. The researcher also analyzed the implementation of the AI-based Cognitive Self-Assessment of Reconstructive Strategy (CRSA) and how it affected the students' cognitive levels and data management when using a writing chatbot. The researcher also analyzed the quality of the participants' written work to measure their level of understanding as a result of the strategy employed. 39 E14 students participated in this research study with the intention of using CRSA to improve the participants' learning outcomes, which is why the descriptive research approach was used to explain the participants' learning outcomes. The method for analyzing data in this study employs a descriptive technique, which is the method that attempts to describe and analyze the AI based Cognitive Reconstruction Self-Assessment (CRSA) strategy in learning, and more specifically, how students' cognitive processes handle and retain information while engaging with chatbots to write academic papers.

RESULTS AND DISCUSSION

Balancing AI and human engagement in learning Indonesian language is vital in evaluating AI's role in language pedagogy. Even though AI obtrudes on pedagogy a number of reinforced applications

to aid learning a language, it cannot replace interactions important in learning a language. For example, while AI pedagogy is strong on the cognitive level in learning a language, it is often the case to the neglect of the emotional and cultural factors, especially those which are important in face-to-face learning interactions. The MLT and Vygotsky socio-cultural learning framework captures the learning emotional, cognitive, and cultural dimensions. The fact that it is commonly accepted that language is a mechanism of communication and the primary driver of social interaction, which is the most sophisticated and integrated of human functions, is often not about the rules and syntax, but how to use language in a socially appropriate manner to fulfil a community's communication needs. In addition, it is important to recognize the growing concern about level of homogenization of thought that may accompany a valuing of AI in learning with the OECD's most recent emphasis on teaching and learning critical thinking and creativity, in addition to the above argue the reliance on AI disenfranchises a number of essential learning human collaboration and creativity within an educational environment. It increasingly appears that AI's learning environment results in a focus on bottom line learning standards defined rather and externally measured than the central level learning standards intrinsic to the educational environment.

The possible uses of AI in the learning process are obvious, yet the depth of the learning and the retention of the materials are subjects of concern. Learning materials and educational environments that use AI offer the students a lot of convenience, but there is a risk of learning only superficially by not engaging deeply or spending time on the materials. Learning the materials deeply is the essence of learning the Indonesian language and literature. Also, the educational inequities caused by the incorporation of AI in education are a big concern. Not all students have the same access to the necessary technologies, and those that do not have access are at an even greater educational disadvantage. It is vital to consider all possible outcomes of the incorporation of technologies in the educational process and to find all potential ways to use technology to close the existing gaps in the learning process rather than to open new ones. In conjunction with other technologies and methodologies, the incorporation of AI in language learning can be a viable option, but it is of utmost importance that the incorporation of AI be done in a way that will retain the human side of education and may even enhance the human side of education. We need to take into consideration the importance of the unique aspects of human contact alongside the advancement of technology, focusing on teaching students language skills while also teaching them culturally and emotionally supportive skills in dealing with the complexities of the modern world—or constructivist learning (Vygotsky, 1978; Latifah, 2024).

Cognitive Strategies in AI-based Scientific Writing

The Cognitive Reconstruction Self-Assessment (CRSA) strategy is an approach that integrates AI technology in the Indonesian language learning process to increase student effectiveness and engagement. Along with language learning technology development, innovative solutions using AI can support Indonesian language lectures, especially in implementing student scientific writing. Cognitive strategies in understanding AI-based scientific papers with problematic use of language in scientific writing, and the use of Indonesian argumentatively and creatively to plan scientific writing. Cognitive processes in writing collaborate with reading skills so students can think critically. Meanwhile, cognitive processes are interrelated because cognitive processes in reading significantly affect comprehension. One of the most famous cognitive theories in reading comprehension is Planning, Attention, Simultaneous and Sequential (PASS) (Maruf et al., 2024). The results showed that applying the evaluative reconstruction method in Indonesian Language lectures successfully increased student engagement and comprehension of the material. Data collected through surveys and observations showed that 88% of students answered that they were more motivated, and 12% answered that they were pretty motivated after applying this method. The reconstruction of teaching materials was carried out by taking into account the needs of students, which were identified through a questionnaire distributed through Google Forms.

A critical lens must be applied to exploring AI tools in the learning process and their effectiveness from all angles. The planning indicator of 70.83% is encouraging, and would suggest improvements to the educational process and outcomes. However, what evidence do you have to support the improvements? Are students learning how to work through the complexities of the real world, or are

they learning how to work through the complexities of real world AI tools and fostering no understanding of the concepts or critical thinking? AI dependence, in particular, is concerning given that 36.70% of students in this study reporting benefit from AI planning tools. AI tools, when used in the correct context, have the possibility to improve the efficiency of task completion, however, this must be balanced with the consideration of the cognitive demands of learning the material to the required depth. Outlining tools, and frameworks, and work structure tools provide students with the means to bypass the cognitive task of critically engaging with the work and the associated learning.

The findings also show that 16.10% of students express that chatbots are helpful when it comes to drafting research papers. Still, while these students may view chatbots as easeful, it is imperative that critical thinking is emphasized. Are students going to be too assisted when it comes to brainstorming and structuring ideas and, as a result, lose out on good creative thinking? The role of learning by doing should also be valued, as this is where one comes from and where one should facilitate learning by doing. The presence of teachers is vital and is part of why students learn to think about contextual and critical issues and not just assist them. Regarding AI based aids, the lack of digital equity and the digital divide in education should be more thoroughly discussed. Are educational institutions thinking about how to solve this problem? With the advent of AI tools, there should be developed appropriate access to technology and education on digital literacy.

Lastly, although Peer-Assisted Scaffolding (PAS) posits a unique way of looking at collaborative learning frameworks, it is necessary to analyze it further. Are these collaborations designed for the better or will they become collaboration kills if not monitored? PAS is dependent on the quality of student collaborations and the amount of control and the quality of engagement an educator is able to incorporate. While the use of technology in the classroom is extremely useful, a more discerning approach is necessary. Reviewing the purpose of the technology in use, the encouragement of critical thinking, the consideration of equity in access to the technology, and the effective organization of collaborative learning will improve the educational experience rather than simply streamlining it. Providing a classroom environment that encourages face to face interaction, just as much as the use of technology, is essential in developing students that are efficient learners, as well as, critical thinkers and innovators.

Implementation of Self-Assessment in Cognitive Processes

The incorporation of AI evaluative reconstructive techniques may revolutionize student engagement in scientific writing tasks. The use of AI in educational settings streamlines processes and promotes more active and reflective engagement in learning. This aligns with the needs of Generation Z, who are more familiar with technology, so applying this method is expected to improve the learning experience. The AI platforms used by students in writing scientific papers are Chat GPT, Gemini, Perplexity, Poe.AI, Humata, Open Read, and Poe.AI; the reason for using these platforms is to assist the cognitive process in developing ideas in the introduction, body, and conclusion. Elaboration between cognitive process and intuition, as well as strategies in composing prompts, are steps that can support access to information more quickly and accurately. The strategy of using imperative sentences is used in selecting clear and specific keywords; ChatGPT can understand a wide variety of keywords, but using clear and specific keywords will help ChatGPT provide more relevant results. In addition, students consistently made patterns by providing context in prompts. ChatGPT could understand the context of the question or text entered. Students' reasoning by providing more context will help ChatGPT to provide more accurate results. Things to avoid are repeatedly repeating the same question or statement, especially if ChatGPT does not provide an answer.

Developing language logicality in prompt generation is crucial in producing well-structured output, especially in interaction with artificial intelligence-based technology such as ChatGPT (Lai, 2024). The ability of students to compose logical prompts affects the quality of output and helps students develop critical and logical thinking skills in scientific writing activities. Students can more easily make revisions based on the feedback provided by the ChatBot system. The process is shown in some self-assessment results in the cognitive process of using language logic in ChatGPT as follows.

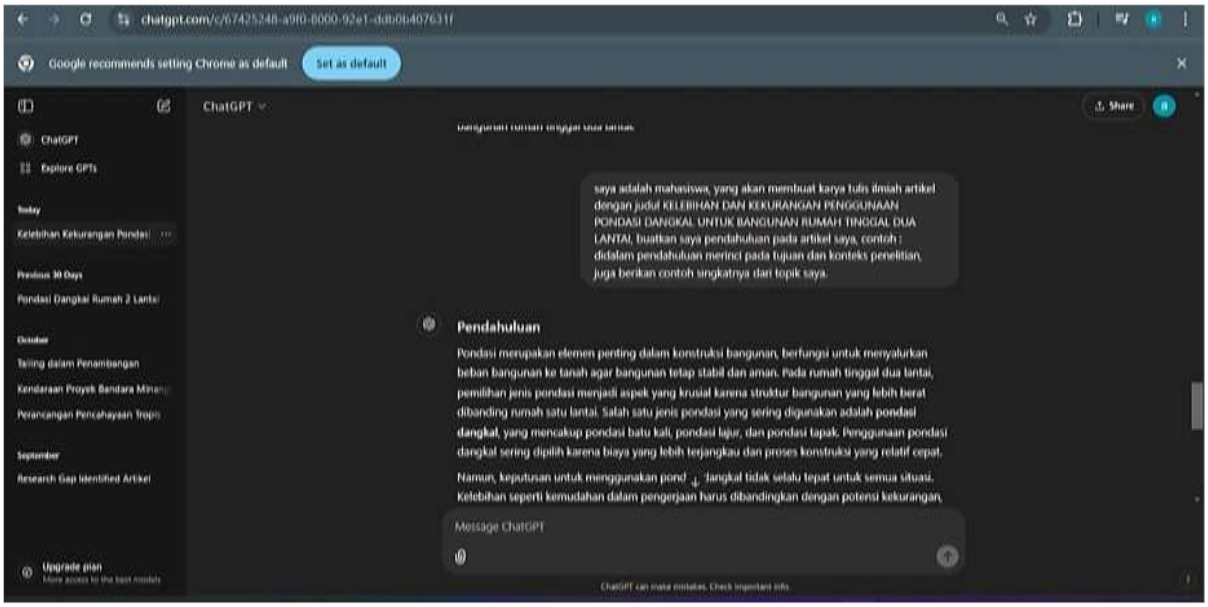

Figure 1. Example of imperative sentence usage in the prompt

Figure 1 above shows that logical, structured, and contextually appropriate prompt generation has a significant impact on the relevance of the information generated by AI. Language logicality includes formulating clear instructions, using specific terms, and establishing a hierarchical structure in the prompt. For example, in the creation of a prompt, insert context and task or imperative sentences of command sentences such as the following;

> "I am a student who will write a paper. In this article, we will discuss the advantages and disadvantages of using a shallow foundation for the construction of a two-story house, create an introduction to my article, for example, an introduction detailing the purpose and context of the research, and also provide a brief example of my topic," more structured prompts produce more complete and systematic output.

} contex

} Task/Imperatif

The prompts written by students display an understanding of both the intricacies of their intended audience and the mental processes involved. A deeper look into this exercise, however, indicates consequences that go beyond the mere mechanics of prompt crafting. To begin with, and aside from the fact that the writing of personal statements and the use of command sentences are more likely to be written with proper sequencing, one may wonder how much control this structured format will exercise over the writer's imagination and, thus, possibly inhibit the drafting of more original and daring concepts. It should be pointed out that it is precisely the absence of definition and the presence of spontaneity that is likely to engender original ideas and that the more format and structure, the more likely one is to inhibit original thinking. A final point focuses on the learning dimension of the self-assessment as a cognitive strategy, which is, in fact, very important, albeit deserving criticism. Self-assessment may improve the prompts and the final outcomes, but it also demands an elevated level of metacognitive control that is not present in all students, which introduces an inequity in the outcomes. While some students may be great in this reflection exercise, others may be very poor and their ability to use AI optimally will depend on this lack. An educational framework creating opportunities for diverse levels of cognitive engagement would better equip all learners, guaranteeing that none are marginalized in the pursuit of proficient communication.

Differentiate between optimal and poor prompts. To say poor prompts lead to optimal outcomes means there is a learning curve, which not all students may be able to follow. One must remember, for some, the expectation of trial-and-error is extemely overwhelming, especially those who are averse to trying out different prompts, highlighting the gap between the expectation of failing and learning and

the urgent need for students to receive instructions that are clear and step-by-step. Yes, there is the consensus that organized prompts lead to organized output, however, there is a tendency, which should have been stated above, to underemphasize the extent to which the importance of poor-quality prompts is a barrier, and the rational limits of the importance of organized, clear, and logical prompt structure are often the borders of high-quality complex and rational arguments. A critical approach to prompts should lead learners not only to produce plainly and unambiguously formulated rational arguments, but to rationally and analytically criticize the underlying idea and everything it touches.

While the findings emphasize the positive elements of structured prompting and self-assessment, they show the need for an appreciation of both the creative and the analytical. Students should be prepared to revise their prompts for clarity and specificity, as well as to interact with the content at a level that encourages the desire to roam, to wander to the uncharted areas of knowledge and not just stay with the organized. As educators and facilitators, our role is to balance these priorities, guiding students towards both effective communication and profound intellectual engagement.

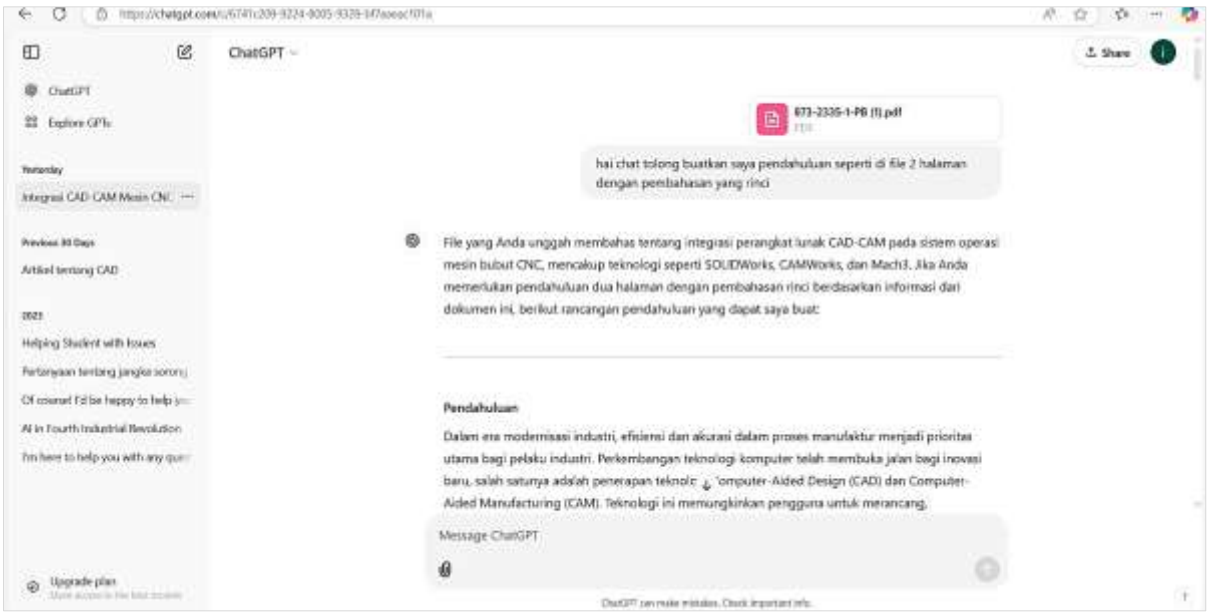

Figure 2. Example of imperative sentence usage in the prompt

Figure 2 above shows that developing a logical prompt involves high metacognitive awareness. Students evaluate the effectiveness of prompts, revise if necessary, and monitor the resulting output. These activities improve the quality of interaction with the AI and encourage reflection on the cognitive strategies used. Furthermore, students develop the process of writing scientific papers by developing an outline through the systematics of scientific writing and developing ideas for the introduction, content, discussion, and conclusion. Cognitive strategies in writing are inseparable from preparing specific and directed prompts to get relevant results from the chatbot. The results of process indicators include interaction with AI. As much as 18.9% of students interact with AI by comparing chatbot output or answers between different platforms. After interacting with AI, the next stage is text understanding, as much as 11.08%; the stage of using AI, as much as 39.20%, where students use chatbots and other platforms to summarise articles and find similar articles. Next is monitoring as much as 7.12%; after finding the answer, students read critically and ask again by adding question points, as in Figure 3.

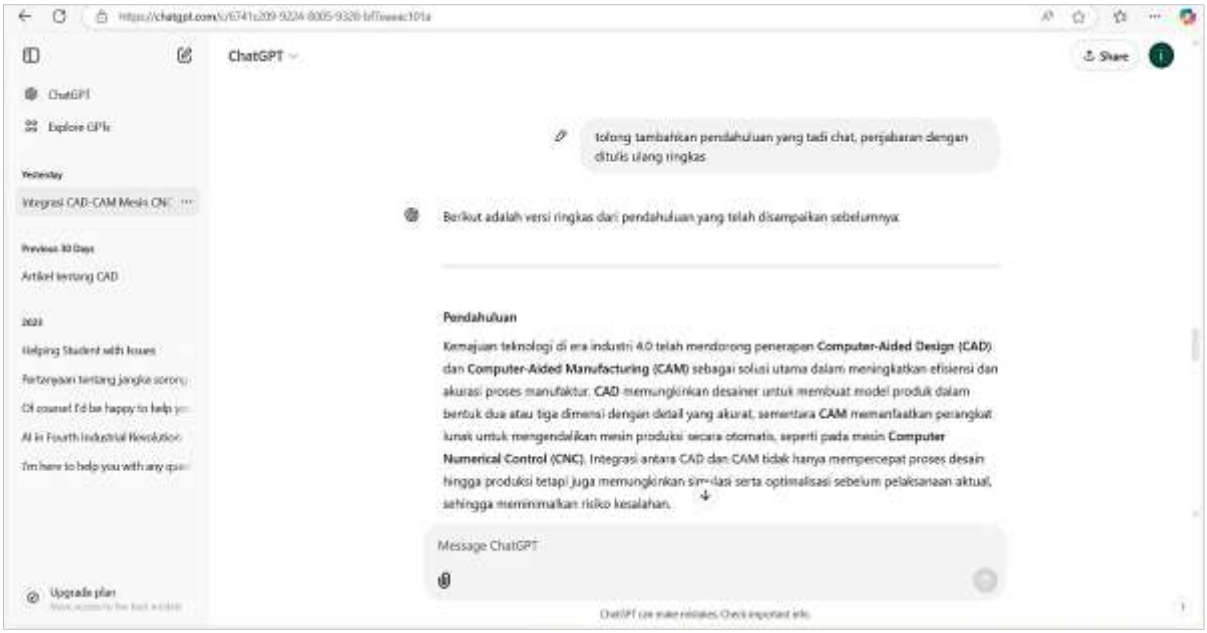

Figure 3. Example of imperative sentence usage in the prompt

This corroborates the observation that students include key elements, such as "please add, improve, perfect" or "explain the relevant theory for research on the effectiveness of AI in learning." With a deeper understanding of each student's learning style and level of understanding, AI systems can provide recommendations and learning materials tailored to their needs. As noted by Muchminiin et al. (2024), this promotes a more individualized type of learning and maximizes student success.

Figure 4. Example of using a sentence to fill in the prompt output

Informed by the results of monitoring, students modified the prompt by incorporating more specific terms of direction. Terms of direction serve to clarify aims, provide direct guidance, and narrow the focus of the system to particular components. By revising using terms of direction, students guided ChatGPT to generate responses that were more appropriate and specific. Prompts that are of the form "Create it again," "Explain," "Elaborate," "Provide an example," etc. are useful in giving ChatGPT the direction it requires to produce responses that are of a more desirable structure. With each round of prompt revision, students assessed how the output had changed. Part of the evaluation is the assessment

of the output in order to identify the changes, if any, that had occurred as a result of the revision. The evaluation of the prompt's output aimed at ascertainig whether the terms of direction articulated in the prompt had, indeed, given rise to more specific and relevant responses. The direct results of observations, especially in the use of terms of direction in the revised prompt, proved that students were able to fully utilize ChatGPT in the learning process The monitoring process, along with output evaluation, provided the necessary feedback, and the revision based on terms of direction also proved to be a viable strategy to circumvent the limitations of the initial output.

Improved structural coherence in outputs was achieved by students who received feedback in the form of instructions such as, "Write the answer in paragraph format with opening, body and closing". Or, "Summarize the main points in a sequential list". Such prompts feature an impersonal order, and the pragmatic interpretation of such an order can range from invitations, to bans, to persuasive moves of other sorts. Students' informational processing capacity remains the core determinant of success in spite of the fact that the ability of chatbots to provide information is virtually limitless.

Monitoring is a strategy that utilized by students to evaluate whether the results given by ChatGPT are consistent with expectations and goals. In this strategy, students review and analyze the response, and then, weigh it against the original instructions. In the event of a mismatch, students

Go back and change the prompt The capacity to adjust and monitor questions demonstrates a considerable degree of metacognitive awareness. Not only do students gain from the experience of engagement with the AI, but they also develop their capacity for analysis and critique. In this particular case study, students' most notable strategy for enhancing the quality of their prompt is role-playing in the imperative, command form. Such language is characterised by instructions, and has been shown to positively impact the ability of AI to respond to specific student requests with appropriate and aligned academic responses. Students monitor for deficiencies, or the absence of, the initial output given by ChatGPT. This encompasses an evaluation of the quality of the generated response in terms of relevance of content, structure and logical flow, and analytical depth. The ability to formulate strategic prompts and critically evaluate chatbot output is are important skill in the context of digital literacy (Yoon, 2023).

Reorganization (Cognitive Reconstruction)

Cognitive reconstruction is a reflection of pulling information in, repeatedly writing with sentence choices that combine cognitive processes and instincts. Quick responses made by students occur because it is essential in recognizing patterns by helping to understand how the brain responds to the next idea. Cognitive strategies in understanding the subsequent scientific work, namely, understanding the concept as much as 15.10%, and the ability to evaluate 6.39% of the results, are an important stage in the information process. Students verify the accuracy and relevance of the topic with ideas or information written by comparing it with other sources; this shows the ability to read critically and read comprehension. The platform is used in cognitive reconstruction by looking for Pembelada between research results: Humata, Open Read, and Google Scholar.

Furthermore, the development of output, as many as 26.12% of students refine ideas, perfect sentences, and word selections based on an evaluation to get more in-depth or specific results. Furthermore, namely constructive revision of as much as 17.20%, the cognitive strategies carried out by students not only train critical thinking skills but also improve the ability to be careful, think critically, and logically in organizing information systematically to support arguments in scientific work. The cognitive process is shown by students who need help designing optimal inter-sentence and inter-paragraph connections so that the results are less relevant or too general. This suggests more structured exercises utilizing AI technology to develop critical writing and reading skills. Formulating a good and effective prompt certainly requires critical thinking competencies so that the ChatGPT response is as desired. Students ' communication competence, logicality, and creativity can be assessed by writing references' quality, depth, and richness (Setiawan & Luthfiyani, 2023). Writing activities involve both technical aspects as well as human intuition integrated with logic. While logic brings structure and clarity, intuition captures the deeper needs and directions creatively. This combination is essential for tapping the full potential of AI-based scientific writing. Intuition is dependent on one's unconscious cognitive processes. These are characterized by the recognition of certain patterns through past experiences, likened to choosing based on mental shortcuts. There are two types of processes in cognitive functions. A) the intuitive system and B) the analytical system. The intuitive system is characterized by being quick and automatic, and relies on feeling or emotions. The analytical system is

slower, and more effortful and relies more on psychological reasoning out processes. The description of the bias towards intuition with the cognitive processes is indicative of the leaning towards the intuitive system. That is, the quick choice is based on some insight that is in the students cognitive processes. The central nervous system controls instinct by triggering automatic responses without conscious brain involvement (Kahneman, 2020). The cognitive process applied by students in writing ideas involves four main aspects: elaboration, organization, repetition, and monitoring. The results showed that these four aspects strategically produce relevant and high-quality critical thinking, especially in developing writing skills such as scientific articles.

The results show that students generate creativity by opening up space for exploring new ideas that may not be imagined analytically. The influence of AI on the quality of writing includes: AI can foster student creativity, so an evaluative attitude is needed, which has implications for using AI in writing scientific papers and developing effective plagiarism evaluation methods. Student rearrangement (*Cognitive Reconstruction*) to produce perfect scientific work in grammar and systematics. Students revise cohesion and coherence errors between paragraphs, errors in the use of compound sentences, or punctuation can obscure the meaning of writing, and the use of citations that are not in accordance with citation standards, because students have succeeded before. This process involves repetitive literacy, such as changing keywords, adding details, or clarifying ideas. In addition, it shows students' ability to evaluate and reorganize scientific work by improving the quality of grammar and writing systematics and strengthening in-depth analysis of the topics discussed. This kind of repetition shows that engaging with AI has the possibility of reflective learning. Such an advance can further integrate Artificial Intelligence with academic writing and maximize the potential in its use. Another research shows that 51.4% of students believed that AI was beneficial in the completion of their final project (Abbas, n.d.). AI assists students in improved quality of their paper because of its capability in literature searching, data processing and information analysis. AI has the potential of enhancing students creativity in writing research papers.

Self-Assessment on Finalization of Scientific Work

Processing information cognitively and applying critical analysis are important skills to have when situational demands require the effective use of knowledge. These skills are far more important than academic exercises when faced with today's knowledge and information challenges. In the Foundations of Knowledge course, students are tasked with the writing of scientific papers and, in doing so, writing with chatbots, and the use of these skills during that process will be the most important. AI tools and feedback will be a secondary consideration. The most important consideration that will make the greatest contribution to learning is the integrated process that occurs once students have learned how to perform a task. The process of learning how to perform a task, or gaining functional skills, is the primary concern. The primary concern, however, is whether we are supporting the development of higher order skills. It is these supporting skills that are more important that will allow the student to integrate the learning more effectively. The research on the CRSA strategy is just the beginning of what potential there is to be done on the feedback process using AI to enhance scientific writing. The balance between personalization and standardization has yet to be achieved in most situations, and that balance is most needed where personalization becomes more than just another checkbox and most needed where students are more than the sum of their parts.

As previously discussed, the CRSA method allows for timely and relevant feedback therefore we need to consider if students know how to interpret feedback positively. Are students simply being given corrections without feedback without consideration to the principles guiding the corrections? True success is claiming students have received feedback. True success is the ability to impute feedback positively to support refinement to their work. This is an area that requires focus. Students have started to reference reputable sources, Springerse and elseviers, and this is a good thing. However their reference diverts from concerns regarding the students critical thinking. Convenience breeds complacency, and it is most likely a reference to a good database that will lessen students need to analyze beyond the database out of curiosity. These resources are a must. However, it is important that students are encouraged to think deeply about the materials. They need to look critically about the materials, ask themselves about the sources and think critically about the reliability and the relevance of the reference. They must avoid thinking about the source at face value.

Moreover, encouraging students to self-reflect may build some skills, but many students lack the ability to honestly evaluate their own work. Self-assessments fail to capture an individuals bias or tendency to inflate their perception of their own skills. Likewise, students may focus too intently on trivial issues and fail to recognize the more systemic issues. There are many reasons students would say their weaknesses are never having a clearly identifiable error. How can we teach students to develop a framework for self-assessing that is informed and accurate? While the CRSA framework may encourage participation and may improve some cognitive functioning, we must consider the obstacles to developing self-initiated, divergent, and complex thought that exist by the time the strategy is completed. Students should develop the ability to view complex issues and context and develop their own solutions. Problem based or inquiry based pedagogy is where learning should shift. Not from completion of tasks, but from the consolidation of knowledge to an inquiry based or questioning attitude.

The educational possibilities of artificial intelligence's real-time analysis capabilities are clear. At the same time, there are ethical issues associated with access to such technology. Relying on AI to evaluate writing leaves the worrying possibility of AI reducing writing to mere reproductive algorithm outputs. Students must be able to view AI as a means to enhance their writing and, in turn, their creativity. In the end, although the AI tools and the CRSA strategy have great potential to improve scientific writing and critical thinking, these methods must be used with a thoughtful and critical approach to find a proper equilibrium in the technology/education equation. Also, education is not about using the latest methods of artificial intelligence; it is about fostering critical thinking and inquisitiveness that goes beyond the individual assignment to the heart of the teaching and learning process.

CONCLUSION

Following the positive outcome of the study, the innovative assessment strategy of Cognitive Reconstruction Self-Assessment (CRSA) facilitates educators in offering constructive feedback, thus fostering the understanding of scientific writing pedagogy and the development of students' cognitive processes. Also, the integration of AI into the strategy enhances students' engagement with AI and the learning ecosystem. The learning ecosystem, through AI-based learning, interactive applications, and chatbots, promotes students' active participation in the learning process and transforms the process into innovative and engaging learning that fosters students' critical thinking and cognitive strategies concerning scientific writing.

The first pedagogical method that uses artificial intelligence technologies, identifying important potential areas of improvement in ways education can be more effective, efficient, and pertinent to the current realities is the method of CRSA. This approach aids in the correction and updating of ways to refine and personalize existing learning paradigms. This new approach offers solutions to current issues, such as a lack of individualized learning processes and the need to address issues around resource allocation. In this regard, the importance of teachers as facilitators and mentors of learning processes continues to be important, especially in regard to the emotional aspect and social skills that AI is incapable of providing. In such a setting, the role of teachers is critical, and in such a setting, the role of teachers is critical as they provide the most important support and emotional support to the students. For teachers to improve their pedagogical digital literacy and be able to provide and effective support to students, they will need to engage in a great deal of training and education in the area of education and the areas of computational intelligence and the areas of computerized intelligence. In the areas of education and the areas of education and the areas of computing, the areas of education and the areas of computing will be integrated into CRSA as a means to provide students with the ability to self-assess and self-assess the areas of education and the areas of computing. For students to be able to critically assess and think reflectively, they must be able to critically assess and think reflectively. Regarding the ability of students to control their thinking and emotional processes, there is a need to ensure the future ability of students to control their thinking and emotional processes to ensure the future ability of students to control their thinking and emotional processes. Regarding the ability of students to control their cognitive processes, there is a need to ensure the future ability of students to control their cognitive processes.

Lastly, future research is warranted to assess the impact of artificial intelligence on the CRSA approach to education. Future studies may offer systematic evidence for the enhancement of the method's reliability, inclusivity, versatility and alignment with future developments in education.

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