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Algorithmically-driven writing and academic integrity: exploring educators' practices, perceptions, and policies in AI era

Leah Gustilo[1*] , Ethel Ong[1] and Minie Rose Lapinid[1]

*Correspondence:
leah.gustilo@dlsu.edu.ph

[1] De La Salle University, 2401
Taft Avenue Malate, Manila,
Philippines

Abstract

Background: Despite global interest in the interface of Algorithmically-driven writing tools (ADWTs) and academic integrity, empirical data considering educators' perspectives on the challenges, benefits, and policies of ADWTs use remain scarce.

Aim: This study responds to calls for empirical investigation concerning the affordances and encumbrances of ADWTs, and their implications for academic integrity.

Methods: Using a cross-sectional survey research design, we recruited through snowball sampling 100 graduate students and faculty members representing ten disciplines. Participants completed an online survey on perceptions, practices, and policies in the utilization of ADWTs in education. The Technology Acceptance Model (TAM) helped us understand the factors influencing the acceptance and use of ADWTs.

Results: The study found that teacher respondents highly value the diverse ways ADWTs can support their educational goals (perceived usefulness). However, they must overcome their barrier threshold such as limited access to these tools (perception of external control), a perceived lack of knowledge on their use (computer self-efficacy), and concerns about ADWTs' impact on academic integrity, creativity, and more (output quality).

Conclusion: AI technologies are making headway in more educational institutions because of their proven and potential benefits for teaching, learning, assessment, and research. However, AI in education, particularly ADWTs, demands critical awareness of ethical protocols and entails collaboration and empowerment of all stakeholders by introducing innovations that showcase human intelligence over AI or partnership with AI.

Keywords: ChatGPT, Academic integrity, Digital writing tools, Academic misconduct, Algorithmic writing

Introduction

Background

The advent of algorithmically-driven writing tools (ADWTs) or AI-powered Digital Writing Tools (AI-DWTs) in today's digital age has unprecedently transfigured how we learn, teach, and research in the academic landscape. The affordances of ADWTs

promised assistance to both learners and educators in the different aspects of educative processes and scientific research. The introduction of these tools is seen as an opportunity to address educational disparities (see McCarthy et al. 2019) by offering learners and educators a wide range of computing tools to make their tasks more efficient. Powered with rudimentary artificial intelligence (AI), ADWTs aid in content generation, form improvement, and evaluation. Spelling and grammar checkers help correct student mistakes in writing (Rahmtallah 2023; McCarthy et al. 2019), while automated essay checkers (Gierl et al. 2014; Wilson & Czik 2016) and plagiarism detection tools (Foltýnek et al. 2020) facilitate the assessment of written works. Recent developments in AI engendered the release of large language models (LLMs), including ChatGPT, which can automatically generate fluent text on various topics (Baskara & Mukarto 2023).

While these ADWTs proffer undeniable opportunities, they also ignite debates centering on academic integrity (Buriak et al. 2023). The academic community is underpinned by an honor system (Buriak et al. 2023) known as academic integrity. This concept refers to the observance of ethical standards and value systems that serve as a canon for decisions and actions in scholarship and education. The keywords summarizing the kernel of academic integrity are ethicality, honesty, and originality. With the increasing reliance on ADWTs, educators and scholars alike are concerned that the principles of academic integrity will be eroded by the prize of efficiency and productivity and that the achievement of pedagogical goals in teaching and scientific publishing is obscured by doubts on whether standards of academic integrity are adhered to by different stakeholders.

Before the release of ChatGPT, educators have already warned of compromises to academic integrity with the widespread usage of machine translators (MTs), such as Google Translate, and digital writing assistants (DWAs), such as Grammarly (Dehouche 2021; Roe et al. 2023). Language models enable access to powerful technologies that not only offer suggestions for content (Duval et al. 2021) but can also reformulate poorly written text, translate text from one language to another, generate summaries from long and multiple documents, give feedback on a given piece of written text (Gao 2021), and even construct articles, essays and stories (Cotton et al. 2024). These developments bring new concerns on how such technologies can be integrated in education while adhering to academic integrity standards (Dehouche 2021; Sbaffi & Zhao 2022).

The availability of ChatGPT has resulted in an increasing number of research papers and news articles reporting the implications of this technology to education. Most of these studies seek to elucidate the social and ethical implications of ADWTs in language and writing instruction classrooms and in disciplines that require writing assignments (Baskara & Mukarto 2023). There is also an emerging research interest that aims to define new practices on the utilization of ChatGPT and other ADWTs in the teaching–learning process, explore the benefits and risks of relying on such tools to achieve the learning outcomes and pedagogical goals and identify steps that can be or should be taken by educational institutions in integrating the use of such tools.

Despite these studies that look into the challenges and benefits of ADWTs and their implications for teaching, learning, and research, few have produced empirical data that are solicited from the opinions of educators regarding their perceptions, existing practices, and policies in utilizing these tools. Hence, this present study heeded calls for an empirical investigation of what educators think, do, and suggest regarding the

affordances and encumbrances of ADWTs in education. For our study, the term "Algorithmically-Driven Writing Tools" (ADWTs) covers four categories of digital writing tools we included in our study: ChatGPT and the three other categories of digital writing tools classified by Roe et al. (2023), namely, (1) DWAs or digital writing assistants (e.g., Grammarly), (2) MTs or Machine Translators (e.g., Google Translate), and (3) APTs or Automated Paraphrasing Tools (e.g., Quillbot).

The current investigation aims at providing explanations for the following research questions:

1. What are the perceptions of educators regarding the use of these tools and their implications for academic integrity?
2. What are the current practices of educators in using ChatGPT, DWAs, MTs, and APTs?
3. What are the policies provided by their institutions and their own suggested policies for the meaningful and ethical use of these tools?

There is already a widespread use of ADWTs that assist educators, learners, and researchers in their tasks even before the release of ChatGPT (Roe et al. 2023; Koh et al. 2022; Roe & Perkins 2022). Examining current practices on using such tools, including ChatGPT, in mainstream education may generate insights to inform the design of appropriate teaching and assessment activities wherein AI-powered technologies are viewed as valuable tools for achieving educational outcomes. Our findings also contribute to the ongoing discourse in reshaping the future of research and publishing, unlocking the full potential of AI-powered technologies in aiding researchers to obtain optimum results in their respective fields (Jansen et al. 2023; Rahimi & Abadi 2023; Wen & Wang 2023). The proliferation of advanced technologies will undoubtedly affect all aspects of our society, not only in the educational space but also in the work environment. Enabling a meaningful integration of technology that maximizes its potential while reducing concerns related to academic misconduct would require a set of educational policies to be in place that can regulate technology use (Lim et al. 2023; Roe et al. 2023). Educators' perceptions and policy provisions regarding the ethical implications of technology utilization can provide inputs in formulating policies on specific areas of learning that may require regulation. This can address the current lack of explicit academic integrity policies and guidelines on using new AI-powered technologies in higher education institutions (Perkins & Roe 2023). Moreover, our findings can be used in the design of intervention programs that can strengthen the important principles of integrity while empowering learners and educators in the effective use of these tools.

Review of related work

AI and the Writing Task

AI-powered Digital Writing Tools (AI-DWTs), a term we interchangeably use with ADWTs, are not new to learners and educators. For decades, they have evolved in sophistication to offer different assistance across varying writing task requirements. Thanks to *Natural Language Processing* (NLP). NLP is a subfield of artificial intelligence that has devoted years of research to developing intelligent computer systems to

decode and generate human language. The resulting tools include machine translators (Rivera-Trigueros 2022; Roxas et al. 2008), automated essay scorers (Landauer 2003), document summarizers (Koh et al. 2022; Mridha et al. 2021), paraphrasing tools (Roe & Perkins 2022), predictive text (Garay-Vitoria & Abascal 2006), story generators (Callaway & Lester 2002; Kybartas & Bidarra 2017), and conversational systems (Kasirzadeh & Gabriel 2023; Schöbel et al. 2023). The continued advancements in computing power combined with the availability of huge volumes of textual data led to large LLMs that enhance the computer's understanding of human instructions, resulting in the generation of more fluent and coherent texts.

For our study, we use "Algorithmically-Driven Writing Tools" (ADWTs) as an umbrella term that covers four categories of digital writing tools we included in our research: ChatGPT and the three other categories of digital writing tools classified by Roe et al. (2023), namely, (1) DWAs or digital writing assistants (i.e., Grammarly), (2) MTs or Machine Translators (i.e., Google Translate), and (3) APTs or Automated Paraphrasing Tools (i.e., Quillbot). We limited our review of ADWTs to these four categories.

Machine Translators (MTs)

Beyond spell checkers and grammar checkers that are now de facto standards in word-processing software, the accessibility of digital writing technologies to generate translated texts in different languages, transform phrases and paragraphs, and even predict the next word(s) have assisted both learners and educators in improving the readability of their written text as well as boosted their productivity. When properly utilized, MTs such as Google Translate, Microsoft Translator, and Itranslate can facilitate communication in multilingual learning environments (Lake & Beisly 2019; Roxas et al. 2008), vocabulary acquisition (Prince 2017), and bilingual composition (Rowe 2022). Furthermore, Cancino and Panes (2021) reported the effectiveness of Google Translate in L2 writing when adequate guidance by instructors complements the students' usage of the tools.

Digital Writing Assistants (DWAs)

Grammarly employed NLP techniques to detect writing mistakes and offer suggestions for improvement. Its generated feedback has been described as a helpful instructional support in enhancing the quality of the written work of learners (Calma et al. 2022), particularly in mechanics and style, through suggested grammar fixes (O'Neill & Russell 2019) and alternative expressions (Barrot 2020). This tool is essential, notably in higher grade levels where learners are responsible for taking necessary actions towards remediating any gaps in their writing skills (Calma et al. 2022). Studies have also revealed Grammarly's potential to enhance learners' understanding of grammar constructs, leading to more confidence in writing (Cavaleri & Dianati 2016). Other grammar checkers available in the digital landscape are ProWritingAid, Ginger, WhiteSmoke, Hemingway Editor, and Language Tool.

Automated Paraphrasing Tools (APTs)

Automated paraphrasing tools (APTs) are digital writing tools that assist the writing process through text transformations (Roe & Perkins 2022). Sophisticated APTs can

transform long spans of text and rewrite materials found online and remain undetected by plagiarism software (Rogerson & McCarthy 2017). These APTs are easily accessible online, enabling students to submit written work compiled from the tools' output without necessarily understanding the content, thus missing the intended learning outcomes and violating originality and authorship requirements. Some of the most popular APTs are Quillbot and WordAI.

Large language models (e.g., ChatGPT)

Large language models (LLMs) are computational systems trained on vast volumes of human-authored texts, which abound in various online sources. They enable a new generation of powerful and brilliant software systems to have a representation of how humans use language for everyday communication that lends them the ability to imitate human thinking, in this case, the writing process. The Generative Pre-trained Transformer (GPT) model is the most popular among the LLMs, with ChatGPT, based on GPT-3, as a prime example of its potential. ChatGPT can encompass nearly all the functions of other aforementioned digital writing tools, from detecting and correcting mistakes in student writing, offering writing suggestions, and paraphrasing, to fully generating fluent text on a vast array of topics and genres that equal and even surpass human writing abilities (Baskara & Mukarto 2023; Taecharungroj 2023).

The increasing sophistication exhibited by ADWTs has been shifting the way they assist in writing from one that is supportive to one that is more collaborative and fully automated. Understanding the capabilities and the critical role of ADWTs may facilitate their proper usage. It can contribute to accessibility, inclusivity, and productivity as reported in prior studies reviewed in this section. For instance, learners can be encouraged to use machine translators to aid in second language acquisition and to gain access to relevant literature written in non-native languages. They can be required to run their written text through automated paraphrasing tools to identify improvement areas and enhance readability before submission. They can also be shown how to use large language models as assistive and personalized learning tools that guide their construction process while remaining in control over the whole writing task. Coupled with appreciating the capabilities and positive benefits that ADWTs may bring to students' learning experiences is to be cognizant of their impact on academic integrity. We present these in the next section.

Impact of ADWTs on Academic Integrity

The introduction and continued advancements of generative AI technologies are changing how people learn and work. Even prior to the release of ChatGPT, the developers of GPT-3 documented several potentially harmful effects of its use, including the spread of misinformation, spam, and dishonesty in academic writing (Dehouche 2021; Lim et al. 2023). Kim (2023), while commending the language model's efficient language editing abilities, illustrated instances when fake references to scientific articles were generated. The benefits of large language models, their proper integration in instruction, and their implications for academic integrity are also the topics of investigation in some recent studies (Bretag & Mahmud 2009; Cotton et al. 2024; Eaton 2022; Dehouche 2021; Roe et al. 2023).

Academic integrity, according to Eaton (2022), is not only concerned with the absence of any form of misconduct but also includes the ethical approaches employed in the whole teaching, learning, and assessment process. Violations of academic integrity, such as academic cheating, are age-old phenomena with roots dating as early as sixth century China (Lang 2013). The ubiquitous use of ADWTs has resulted in the proliferation of academic misconduct in the contemporary era, which in turn brought significant attention and discussion surrounding the forms of academic dishonesty and academic integrity principles that have been violated, particularly when there are doubts about the authorship of the submitted work. One form of academic dishonesty is contract cheating, where an external party is solicited to perform the written assignment. Traditionally, these are paid third-party service providers, friends, and family members. The Internet enabled third-party providers to move their services online, offering broader access to the educational sector, particularly students (Eaton 2022). With large language models, students gain direct access to technology-based learning assistants, some of which are free, thereby shifting the third-party service providers from human to AI. Plagiarism is another expression of academic misconduct that surfaced in the fifteenth century with the emergence of the printing press (Eaton 2021). It became more pronounced with the availability of vast online written material collections and editing (copy-paste) features in word-processing tools. Students resort to copying intellectual work from sources to complete written assignments without observing proper paraphrasing and attribution to the original authors (Bretag & Mahmud 2009). Because large language models generate text using training data from various existing digital resources, attributing original authorship becomes a complicated issue. This idea adds a layer of complexity in determining whether or not the written text generated or influenced by AI can be considered plagiarized.

In addressing the academic integrity implications of ADWTs, Roe et al. (2023) raised a valid concern about the intentionality of student actions. For instance, soliciting third-party providers to write one's assignment may be viewed as intentionally violating academic integrity, while asking parents for advice on improving one's writing or discussing a written assignment with a peer to facilitate idea generation may be considered unintentional misconduct. Similarly, with technology, submitting an AI-generated essay as one's work may be construed as contract cheating, while utilizing built-in predictive text offered by word processors or having Grammarly offer suggestions to improve one's writing may be perceived as valid uses of technology. Since ChatGPT offers both text generation and text editing facilities, it is still being determined where to draw the boundary line separating acceptable academic behaviour and academic misconduct. Therefore, educators are encouraged to shift their efforts from policing academic misconduct to identifying why students may utilize AI tools to complete their assignments (Indiana n.d.). Determining the causes of intentional and unintentional actions can inform the formulation of appropriate policies and guidelines and the provision of relevant awareness programs on properly using these AI-powered technologies that adhere to academic integrity principles.

Educational policies on the meaningful and ethical use of technology

As the number of students and researchers who use AI-powered technologies to complete their tasks continues to grow, studies have reported mixed findings and recommendations regarding the utilization of AI-powered technologies in the academe (Adiguzel et al. 2023; Cassidy 2023). Research investigating the ethical use of AI in teaching, learning, and assessment cautioned that these technologies may lead to cheating and fraud and compromise our core human values of honesty and integrity (Cotton et al. 2024; Dehouche 2021; Eaton 2021). Previous studies have also called for formulating and revising educational policies and guidelines to prevent and detect academic misconduct in submitted work and propose alternative assessments that minimize the use of AI-powered technologies (Cassidy 2023; Lim et al. 2023).

An analysis of 142 academic integrity policies of higher education institutions related to the use of ADWTs revealed a gap in explicitly mentioning "AI", according to Perkins and Roe (2023). This underscores the call for revisiting and revising relevant policies and regulations to explicitly mention the implications of ADWTs to learning while emphasizing the proper and ethical use of these technologies. Chan (2023) described an AI educational policy framework that was derived from examining the perceptions among the teaching staff in Hong Kong universities regarding the integration of generative AI technologies in education. The resulting framework contains three (3) dimensions: pedagogical, governance, and operational; and it requires strong collaboration among key stakeholders that include institutional leaders and administrators, teaching staff, and students for its successful implementation. The pedagogical dimension encourages educators to adopt AI technologies to equip students for an AI-driven workplace. Technology use, however, should be tied to pedagogical practices and learning theories when designing instructional materials and learning activities (Adiguzel et al. 2023). The governance dimension urges institutional leaders to attend to ethical concerns through policies that promote accountability and the responsible use of AI that center on human well-being and values (Dignum 2019). The operational dimension acknowledges the need for training, support, and monitoring of appropriate AI technologies.

Educational reforms that embrace the meaningful use of AI-powered technologies should also focus on the innovative opportunities these may bring to the various educational processes. The ubiquitous nature of technology already embedded into popular software applications and has become indispensable in helping the academic community carry out its everyday tasks should be recognized in such policies and reforms. Eaton (2022) warns that there is no simple solution to preventing academic misconduct using ADWTs. Instead, she encourages educators to emphasize student learning as it is "*our ethical obligations for learning, teaching and assessment to include a human focus to promote student success*" (Eaton 2022, p. 2). Academic integrity advocates echoed similar sentiments (Bretag & Mahmud 2009). Ouyang and Jiao (2021) proposed two human-centric paradigms in utilizing AI in education: *AI-supported*, where the learner collaborates with the ADWTs to perform the required learning task, and *AI-empowered*, where the learner exercises agency and control over their learning.

Technological Acceptance Model

Drawing from previous studies on the usefulness and potential risks of technology in education, we adopt Davis' (1989) Technological Acceptance Model (TAM) to understand educators' perceptions, practices, and proposals regarding the use of ADWTs. TAM suggests that the design features of technologies influence individuals' cognitive responses (i.e., perceptions about usefulness and ease of use), which in turn trigger their intention to use the technology. This intention subsequently fuels their actual use of the technology. Perceived usefulness is determined by factors such as image (i.e., technology use enhances one's status), output quality (i.e., the quality of technology in performing tasks), result demonstrability (i.e., performance due to technology use is tangible), subjective norm (i.e., following the social group's opinion), and job relevance (i.e., the tool is applicable to one's job). Perceived ease of use, on the other hand, is constrained by perceptions about computer self-efficacy (i.e., belief that one has the skill to use the tool), external control (i.e., belief that an individual has institutional support to use the tool), computer anxiety (i.e., fear of using computers/technology), computer playfulness (i.e., cognitive spontaneity in microcomputer interactions), perceived enjoyment (i.e., enjoyment in using the tool), and objective usability (Marikyan & Papagiannidis 2023).

Applying this framework to the present study, we posit that educators' perceptions of the usefulness and ease of use of ADWTs influence their decisions to integrate these tools into their teaching, learning, and research practices. They also impact their policy proposals for the ethical and effective use of ADWTs. Perception of usefulness encompasses the general purpose of ADWTs use, which is dictated by the range of tasks in the teaching and learning processes, from course conceptualization and development to content creation, assessment, and feedback (Horváth 2019). Perceived ease of use, conversely, includes beliefs regarding one's ability to use the ADWTs efficiently and beliefs that institutional support to use the tools exists.

The TAM framework also claims that perceived ease of use and perceived usefulness capture users' expectations that technology use will lead to positive behavioural outcomes (Davis 1989). These two factors are crucial in rationalizing the perceptions that arise with the adoption of ADWTs and the continued hesitation of educators to employ new technology-based instructional methodologies in their classroom and research practices (Istenic et al. 2021).

In a study by Kim and Kim (2022) on the adoption of AI tools to scaffold STEM education, they identified several issues that may hinder educators' adoption of AI tools. These include the unclear boundary that differentiates the educator's role from that of AI and the validity and alignment of the AI tools' outputs with those of the human teacher. Tallvid (2016) reported that educators reject the utilization of new teaching methodologies if these tools may lead to negative outcomes. The perceived impact on academic integrity and the potential negative consequences for educational outcomes can undermine the adoption rate of new technologies such as ADWTs. Therefore, the TAM framework can also be used to understand the educators' perceptions that influence their actual practices in integrating ADWTs, which is integral to the formulation of educational policies on the meaningful and ethical use of ADWTs. It should be noted at this point that not all the antecedents of TAM are explained in

our analyzed data. Only computer self-efficacy, job relevance, results demonstrability, output quality, and perceptions of external support find exemplifications from our current data.

Methods and materials

Participants

Using a cross-sectional survey research design, the present study recruited through snowball sampling a total of 100 educators. We invited an initial set of 60 faculty and graduate students from a leading university in the Philippines who are active in teaching and research. Their involvement was sought through formal invitations via Viber, email, or Facebook Messenger. Participants were made aware of the risks and benefits of participating and assured of confidentiality of their responses. They were made to understand that they were not obliged to participate, could opt out of answering any of the questions or withdraw from their participation at any time without the need to justify their action. A link to the Google form containing the informed consent and details of ethical considerations was provided for the participants before they proceeded to the survey questions. The initial 60 respondents sent our electronic instrument's link to their primary, secondary, or tertiary education colleagues. Since our initial participants are scattered in Asia and the USA, they also recruited participants in these regions. This process continued iteratively until we could no longer identify new participants, which incidentally totalled 100 naturally.

A clear majority (77%) of the respondents are teaching faculty, while one-fifth of the respondents hold both administrative and teaching positions. Please see Fig. 1. The teaching participants are faculty from various disciplines: English and applied linguistics, mathematics, science, computer studies, business, accounting and economics, sociology, history, and literature. Sixteen (16) of the respondents have been teaching Research Methods. Other courses taught by them are the major courses in their disciplines. Please see Fig. 2. Fifty-two percent (52%) of the respondents have earned their PhDs, while almost half of the rest have earned their master's degrees, and the remaining were still in their academic coursework at the master's level. Please see Fig. 3. Only 10% of the respondents have less than three years, and
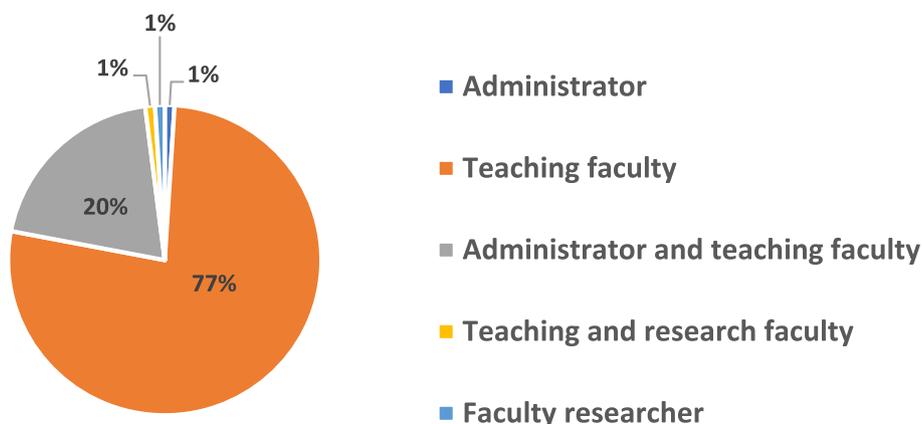

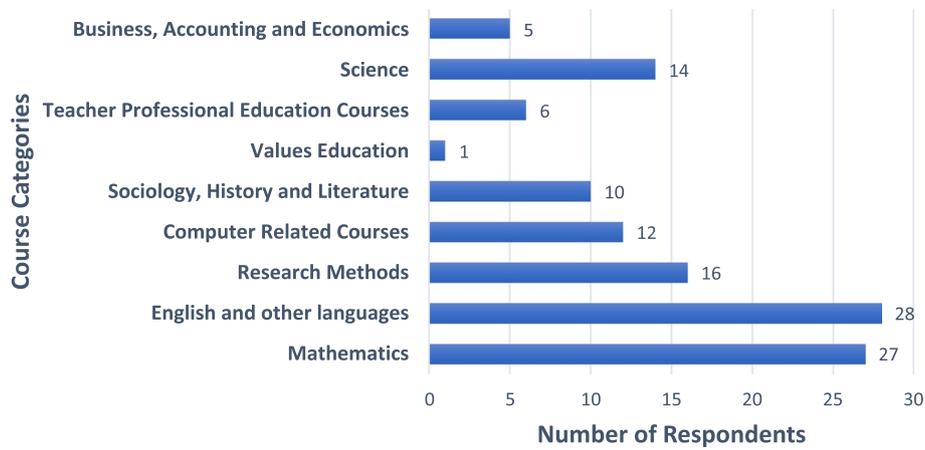**Fig. 1** Respondents' Work Positions

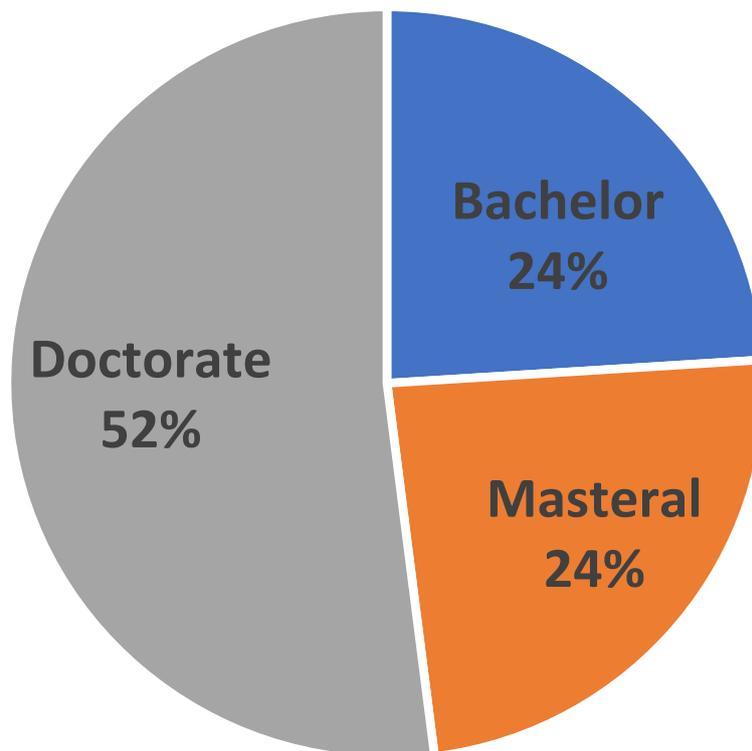**Fig. 2** Courses taught by respondents

Fig. 3 Respondents' Highest Educational Attainment

a majority of the respondents have been in the teaching profession for more than six years with research experience. Please see Fig. 4. Fifty-three percent (53%) are female, forty-six percent (46%) are male, and only one percent (1%) declared his gender is non-binary. Their age ranges from 23 to 62 years old.
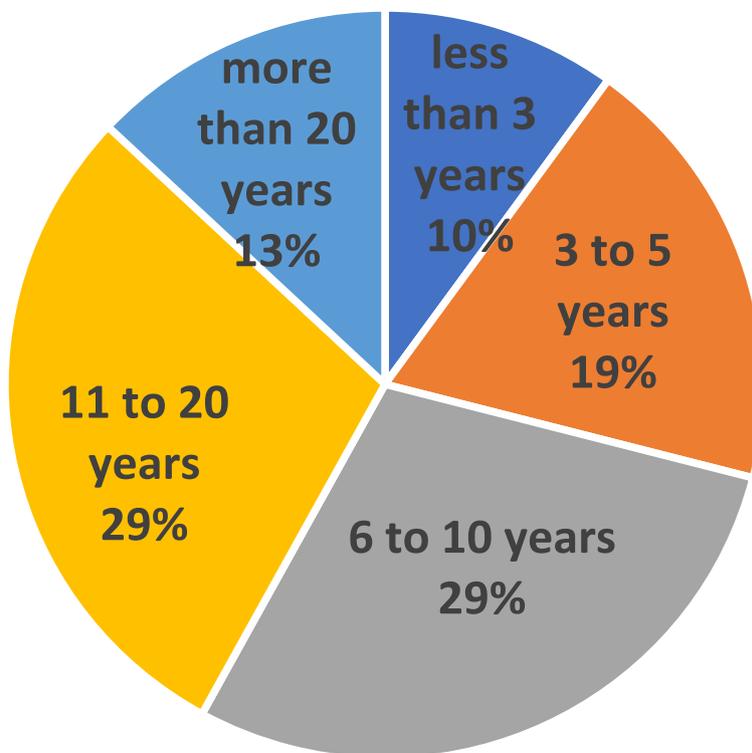
Fig. 4 Years of Teaching/Research Experience

Procedures

We collected data using the researchers-made survey questionnaire consisting of 4 parts that elicited the following: participants' demographic profiles, practices in using, perceptions about, and policy suggestions for using ChatGPT, DWAs, MTs, and APTs.

The perceptions about using ChatGPT and other ADWTs consist of 17 items, 10 of which use a 5-point Likert scale with 1 and 5 corresponding to "Strongly Disagree" and "Strongly Agree," respectively. Items 1 to 3 measure educators' knowledge, skills, and intention in using the tools. Items 4 to 6 elicit educators' perceptions of the benefits and challenges of integrating ADWTs into teaching and research. Items 7 to 10 collect data regarding educators' perceptions of the policies for these tools' effective and ethical use. Hence, these items in the scale measured skills, knowledge, intentions, benefits of the tools, and their concerns about policies in using them. The ten items on perceptions have Cronbach's Alpha reliability coefficient of 0.85, which indicates a good internal consistency for the scale (George & Mallery 2003). Open-ended questions were framed to allow participants to elaborate further and explain their concerns and perceived benefits of using the said tools. Questions about educators' practices in using ChatGPT and other ADWTs consist of whether or not they have used the applications, frequency of use, purposes, tasks, and how these tools are incorporated into their teaching and research. Participants were likewise interrogated if they thought the use of these tools should be regulated or completely banned from coursework and research-related tasks. The last portion of the questionnaire elicits their institutional policies for conducting training, provision of guidelines and regulations, and resources for using ADWTs. We gave the

link to the Google form only after the respondents gave informed consent to participate in the survey. Participants were requested to respond to the study at their convenience in one week.

Descriptive Statistics was used to analyze and explain the quantitative data. Specifically, we did a frequency count and computed the mean to determine the popular and the average responses. We used the standard deviation to measure their responses' degree of harmony or variability.

As regards the qualitative data, inductive and deductive thematic analyses were conducted. The goal of thematic analysis was to identify the patterns and themes from the qualitative dataset that could address the study's research questions. For the analysis of the two open-ended questions: (1) How do you incorporate ChatGPT in your research, and (2) What resources do you wish your institutions to provide for you, we modified Kim and Kim's (2022) methodological framework in their thematic analysis of teachers' perception data on using AI for scientific writing. Our inductive analysis involved five steps.

> 1. First step: familiarization and N-gram analysis. We read the survey responses for familiarization with the recurring keywords. The Discourse Analyzer AI toolkit was also employed to conduct an N-gram analysis of survey responses to identify recurring phrases or terms (See Appendix 1 for an example of an N-gram analysis by the Discourse Analyzer AI toolkit). This AI tool has an intuitive interface and demonstrates accuracy in identifying themes or topics in discourse—which is why this tool was used for this study.
> 2. Evolving initial data-driven codes. Initial codes for the category of survey responses were developed by the first author based on the keywords and phrases identified related to the research questions. The first author did an independent coding of the responses by placing the segmented data in a table format with the survey responses in one column and applying the initial codes line by line in the opposite column. Additional codes were added to the initial set during the coding process.
> 3. Reviewing and refining the codes. After the first author coded all the data, the codes were reviewed, separating or lumping together similar codes that refer to the same meaning but were worded differently.
> 4. Establishing Inter-Coder Reliability. The second author coded the survey responses using the codes created by the first author. However, when disagreements in the coding of responses arose, the second author suggested renaming the codes or adding new codes. When the two coders disagreed, the third author was asked to also code the disputed coding. Inter-coder reliability between the first and second authors was computed using percent agreement. The average percent agreement across the two datasets is 90.2, which is considered high. However, 100% percent agreement was achieved during the consensus discussions involving all three coders (see Appendix 2 for sample coding).
> 5. Reducing bias in coding through cross-validation of human codes with AI-generated codes. The plain text cleaned data were run in the Discourse Analyzer AI Toolkit to generate codes to validate if these AI-generated codes were similar to human-coded data (see Appendix 3 for an example of AI-generated codes). We

achieved a 100% accuracy match between the Discourse Analyzer AI-generated codes and the human-generated codes in terms of the meaning of the coded concepts. Slight differences in the code labels between human codes and AI codes were observed. However, in the end, human codes were fewer because some of the codes were combined with similar codes referring to the same function or meaning.

5. Categorizing into bigger overarching themes. The coded categories of survey responses were further categorized into overarching themes in the final stage. The Discourse Analyzer AI toolkit was utilized to extract overarching themes from the dataset (see Tables 4 and 5 for the overarching themes extracted by AI). The AI-generated overarching themes were used to classify the manually coded survey response categories into corresponding themes. However, some coded categories were rearranged by human coders to fit the overarching AI-generated themes. The cross-validation of human-coded data and AI-coded data yields fairness and accuracy because AI coding minimizes biases and human coding validates and incorporates what AI misses.

For the analysis of educators' concerns about using ADWTs in teaching and research, a combination of deductive and inductive coding was used because it utilized pre-determined themes from existing literature and emergent themes from the data. This combined approach followed five steps.

1. Data familiarization. We read the data to get a sense of the overall content.

2. Development of coding framework. Drawing on Rahman and Watanobe's (2023) *ChatGPTs threats in Education and Research*, Roe et al's (2023) *AI's Implications for Academic Integrity in the Language Classroom*, and ChatGPTeachers. net's (2020) top seven fears of using ChatGPT, the first author developed codes to be used in coding the themes. New themes were added as new themes not mentioned in the existing literature were observed during the coding process.

3. Applying the Coding Framework. The first author applied the coding framework to the survey responses by assigning codes to the segmented text line by line in a table format similar to the analysis of the first two datasets in inductive coding.

4. Reviewing and refining the codes. After the first author coded all the data, the codes were reviewed, separating or lumping together similar codes referring to the same meaning but were worded differently.

5. Establishing inter-coder reliability. The second author coded the survey responses using the codes created by the first author. However, when disagreements in the coding of responses arose, the second author suggested renaming the codes or adding a new code. When the two coders disagreed, the third author was asked to also code the disputed coding. Inter-coder reliability between the first and second authors was computed using percent agreement. The average percent agreement across the two datasets is 97%, which is very high. However, 100% percent agreement was achieved during the consensus discussions involving all three coders.

Results

Part 1: Educators' perceptions in utilizing ADWTs and their implications for academic integrity

This part of the analysis delved into the educators' perceptions regarding their knowledge of ADWTs, the opportunities and risks in utilizing ADWTs in teaching and research, and what they think should be done to use these tools ethically and effectively.

First, we present the results of the survey questionnaire in a Likert-scale response format. Table 1 shows the frequency counts, means, and standard deviations of the educators' responses to the perception questions with a five-point Likert-scale response format. Items 1–3 measure the educators' knowledge, skills, and intentions in using the AI tools in question. Their mean values of 2.87, 2.60, and 3.13 fall in the neutral range, and their respective standard deviations of 1.34, 1.31, and 1.29 indicate a low level of variability. Items 4–6 measure the educators' perceptions regarding the affordances of AI tools for their teaching, research, and learning. Their mean values of 3.43, 3.40, and 3.51, with their respective standard deviations of 1.17, 1.21, and 1.12 indicate the *Agree* range and a lower level of variability. Items 7–10 measure the educators' concerns about the need to implement policies in the use of these tools. Item 7, which asks about educators' awareness regarding the dangers of the tools, has a mean value of 4.32 with a 1.14 standard deviation, indicating a *Strongly Agree* range and low level of dispersion. Items 8–9, which advocate for requiring students and faculty to inform the readers regarding their use of ChatGPT or other tools in question in their written outputs, fall within the range of *Agree* as their respective means are 3.95 and 3.77. Their standard deviations (1.23 and 1.29) are within low levels of dispersion. Item 10, which asks about banning DWAs, MTs, and APTs, is the only item with a *Disagree* range with a mean value of 2.53 and a standard deviation of 1.36, suggesting a lower level of variability in the responses

In addition to the tabular presentation of the perception survey results in Table 1, we created Fig. 5 to show an aggregated stacked bar graph that visually represents the frequency count of teacher responses in each level of agreement per item. Fig. 5 shows which of the opposite responses between agreement and disagreement is more dominant in each item. As shown in Fig. 5, all items, except numbers 2 and 3, are consistent with the mean score interpretations. The mean scores for numbers 2 and 3 show neutral responses. The frequency counts, as can be gleaned from the figure, further clarify that more educators *disagree* with the statement that they have sufficient skills to coach their students to use ChatGPT. More educators *agree* with the statement intending to use ChatGPT and other DWAs. The *educators' lack of confidence* finding in the quantitative survey is consistent with their qualitative replies: "*We lack training in the use of these tools,"* and "*I am not confident using these tools.*" (See Fig. 5).

Second, we present our perception data regarding which tasks/domains of ChatGPT should be regulated or completely banned. There is a significant majority of responses that lean toward regulating ChatGPT, with more than 60% of the respondents favouring the regulation of ChatGPT in formative tests (65%), thesis (64%), dissertations (62%),

Table 1 Frequency count, mean and standard deviation of perception responses ($n = 100$)

Perceptions	StronglyDisagree	Dis-agree	Neutral	Agree	StronglyAgree	Mean	Interpret-ation	SD
1. I have sufficient knowledge of how to use ChatGPT and other AI-powered DWTs under discussion	22	20	17	31	10	2.87	Neutral	1.34
2. I have sufficient skills to coach my students to use ChatGPT and other AI-powered DWTs under discussion	27	23	22	19	9	2.60	Neutral	1.31
3. I intend to use and keep using ChatGPT and other AI-powered DWTs under discussion	19	8	26	35	12	3.13	Neutral	1.29
4. ChatGPT and other AI-powered DWTs are helpful for my teaching-related tasks	10	8	29	35	18	3.43	Agree	1.17
5. ChatGPT and other AI-powered DWTs are useful in my research-and-publishing-related tasks	12	6	30	34	18	3.40	Agree	1.21
6. I believe that ChatGPT and other AI-powered DWTs are helpful for my learning	7	11	24	40	18	3.51	Agree	1.12
7. I am aware of the dangers of ChatGPT if educators and institutions do not set clear policies for its ethical use	8	0	5	26	61	4.32	Strongly Agree	1.14

Table 1 (continued)

Perceptions	StronglyDisagree	Dis-agree	Neutral	Agree	StronglyAgree	Mean	Interpret-ation	SD
8. Institutions should require their students to report their use of Chat-GPT and the other afore-mentioned AI-powered DWTs in their graded outputs	8	5	15	28	44	3.95	Agree	1.23
9. Institutions should require their faculty to report their use of ChatGPT and the afore-mentioned AI-powered DWTs in their reports, research, and other performance tasks	10	8	13	33	36	3.77	Agree	1.29
10. Students should not be allowed to use Digital Writing Assistants (DWAs) such as Grammarly and Automated Paraphrasing Tools such as Paraphrase Online in outputs in which grammar, punctuation, mechanics, and organization are graded	28	30	15	15	12	2.53	Disagree	1.36

reports (81%), short essays (72%), and coursework-related research (68%). On the other hand, there is also a clear majority of responses toward completely banning ChatGPT in summative tests (55%), licensure examinations (77%), and course-related qualifying examinations (73%). There is a 50–50 split of decisions for diagnostic tests, with half of the respondents favouring ChatGPT's regulation and another half favouring its complete ban (See Fig. 6).

Third, aside from the listed tasks, we also asked the educators to list other tasks in which ChatGPT should be regulated or banned. In general, there is a mixed sentiment
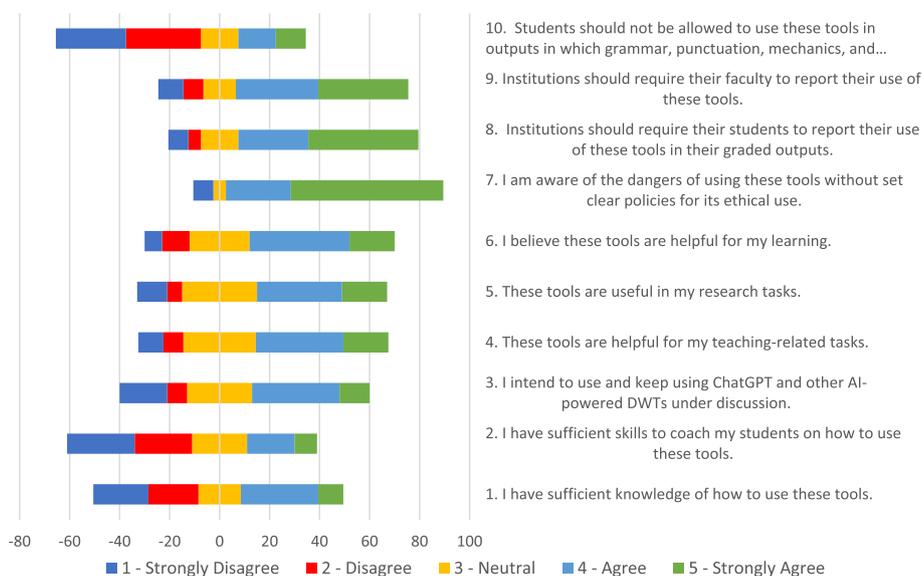
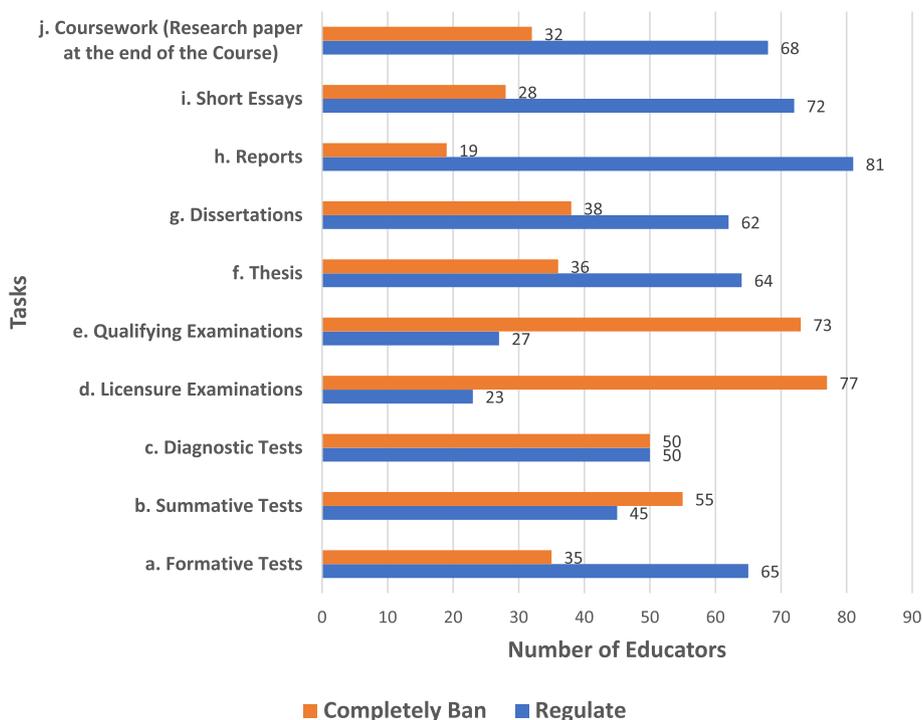**Fig. 5** Educators' Perceptions of the Use of ChatGPT and other ADWTs

Fig. 6 Educators' Responses Regarding Banning or Regulating the ChatGPT in Different Writing Domains

over banning or regulating all proficiency-related, micro, or macro language tasks, with some saying they should be completely banned and some favouring that they should be regulated. They also recommended the banning of ChatGPT in all tasks involving mathematical calculations.

Fourth, we asked about the allowable percentage of AI-generated text in faculty and students' written outputs. We listed four options: less than 10 percent, 10–15 percent, 16–25 percent, and 26–50 percent. Option b, 10–15 percent, was the most frequent response, with 39 respondents. This is followed by the first option, less than 10 percent, with 36 respondents. Options c (16–25 percent) and d (26–59 percent) received only 18% and 7% votes from the respondents (See Fig. 7).

Fifth, we asked the educators' concerns about ChatGPT and the other ADWTs in teaching. This question requires a short answer. We did a thematic analysis of their responses. Table 2 presents the 11 answer categories of the responses, an example for each answer category, and the frequency of occurrence of the thematic categories. The top five recurring themes with more than ten occurrences each include: (1) becoming too dependent on the tools; (2) declension of students' creativity, proficiency, or critical thinking; (3) concerns about validity**,** accuracy, authenticity, and reliability of the AI-generated outputs; (4) ethical concerns (accountability, trust, misuse and abuse, transparency); and (5) assessment concerns (how to assess uniform answers, difficulty in differentiating AI-generated content and Human-produced content. The other themes with one to seven occurrences each are as follows: (1) losing control due to lack of guidelines; (2) lack of training or technical expertise in tool usage; (3) becoming lazy and complacent; (4) replacing or surpassing humans; (5) hindering the development of interaction and other skills related to student–teacher relationships; and (6) cost.

Sixth, we asked educators regarding their concerns about ChatGPT and other ADWTs in research. Table 3 presents the answer categories of the responses, an example for each answer category, and the frequency of occurrence of the themes.

As shown in Table 3, we found nine (9) answer categories from the responses of the educators. The top five recurring answer categories with seven or more occurrences each include: (1) Ethical Concerns, i.e., accountability, honesty, bias, misuse and abuse, transparency; (2) Concerns over the reliability, accuracy, and validity of outputs; (3)
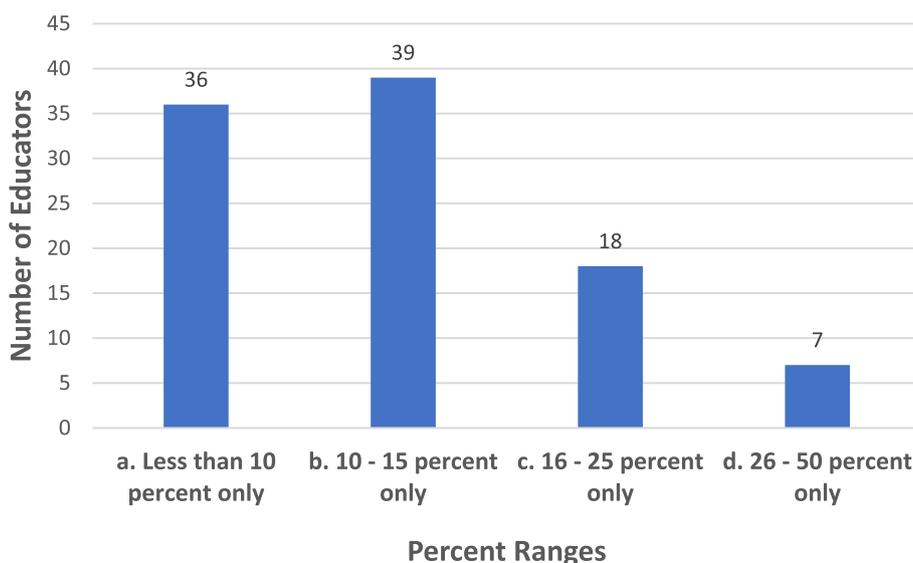

Fig. 7 Allowable percentage of AI-generated text in faculty and students' written outputs

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Table 2 Categories, examples, and frequencies of teachers' concerns regarding ChatGPT and other AI-powered DWTs in teaching

Answer Category	Example	Frequency
Becoming too dependent on the tools	*The risk is that teachers might end up becoming too dependent on these tools and thus degrade their knowledge and skills to create original content*	25
Declension of students' creativity, proficiency, or critical thinking,	*Dependence on these tools will result in a decline in the student's proficiency level* *Excessive use of ChatGPT limits students the opportunity to develop creative and innovative ideas concerning academic tasks*	21
Concerns about validity**,** accuracy, authenticity, and reliability of the outputs	*These tools may only sometimes provide accurate and reliable responses; hence, they might lead to inaccurate outcomes in teaching or research*	20
Ethical Concerns (accountability, trust, misuse and abuse, transparency)	*Ethical concerns. Integrity might be impaired. Increases the tendency of cheating*	18
Assessment concerns (how to assess uniform answers, difficulty in differentiating AI-content and Human-content)	*Teachers might be misled into believing that their students have acquired the competencies for the subject, but they are assessing an AI's work rather than their students' work*	11
Losing control due to lack of guidelines	*The unrestricted use due to lack of guidelines might result in chaos*	7
Lack of training or technical expertise	*One of the most difficult challenges is the lack of technical expertise*	5
Becoming lazy and complacent	*Teachers and students will be complacent*	4
Replacing or surpassing humans	*Its potential for the replacement of humans in writing-intensive work*	4
Hindering the development of interaction and other skills related to student–teacher relationships	*An overemphasis on AI tools risks diminishing the significance of human interaction in education, possibly weakening teacher-student relationships and hindering the development of socio-emotional skills*	1
Cost	*Another issue is the high cost of AI tools and applications*	1

Becoming too dependent on the tools; (4) Hinder the development of researchers' skills; (5) Becoming impersonal and lacking human touch; and (5) Concerns over the proliferation of AI-written content and turning these tools into publication machines. The other categories with one to three occurrences each include*: (1)* Promoting laziness and complacency; (2) Robbing researchers of the opportunity to make their own meaningful contributions, and (3) Inequality resulting in disparity in research quality.

Part 2: Educators' practices in using ADWTs

Part 2 of the analysis delved into the responses of 100 educators regarding their practices in using the ADWTs in question.

First, when asked whether or not they use the ADWTs in question, the plurality of the surveyed educators said they use DWAs (85%) and MTs (75%). More than half of the respondents use APTs (51%), and less than half utilize ChatGPT (48%). Second, when asked about the frequency of their use of ADWTs, the response that received higher frequencies across four categories is *Occasionally:* ChatGPT (32%), MTs (48%), DWAs (44%), APTs (33%). Please see Fig. 8.

Some educators who have not used these tools expressed interest in learning and using them. Others gave their reasons for not using the ADWTs, such as, "*I just*

Table 3 Categories, examples, and frequencies of educators' concerns regarding ChatGPT and other ADWTs in Research

| Answer Category	Examples	F
Ethical Concerns: (e.g., accountability, trust, misuse and abuse, transparency)	*Researchers can claim work that is not their own* *A major concern regarding AI in academic writing is plagiarism. Using ChatGPT without proper citation or attribution of sources can result in academic dishonesty*	26
Concerns over the reliability, authenticity, accuracy, and validity of outputs	*Many of its suggested sources are not searchable on Google, websites, and databases. It also produces inconsistent data analysis of quantitative data*	25
Becoming too dependent on the tools	*Researchers might rely on them too often*	11
Hinder the development of researchers' skills	*The researcher's skills may not be fully honed as the AI takes the responsibility of completing major writing tasks*	10
Becoming impersonal lacking human touch	*It lacks the human touch; there are other intricate and idiosyncratic characteristics of human writers which cannot be copied by AI*	7
Concerns over the proliferation of AI-written content and turning these tools into publication machines	*That articles will be written by AI* *Since educators are required to publish, many will use such tools just to be able to publish research papers quickly*	7
Promoting laziness and complacency	*Writers, both students and professors, will become lazy if they rely on these tools*	3
Robbing researchers the opportunity to make their meaningful contributions	*Allowing AI technology to write what a researcher can and should be able to do themselves robs them of the opportunity to truly make meaningful contributions to their field by their abilities to truly understand the context of the problems they challenge*	1
Inequality resulting in disparity in research quality	*Unequal access to AI-powered DWTs raises concerns about disparities in research quality and opportunities, as financial resources and technological infrastructure may vary across researchers and institutions*	1
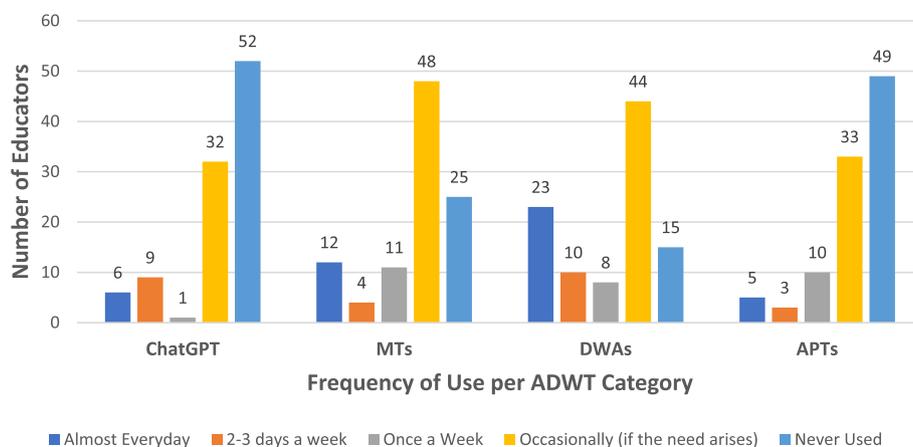
Fig. 8 Educators' frequency of use of ADWTs

recently heard about ChatGPT from my classmate in the Ph.D. program," "I don't have the need yet for Google Translate," "We lack training in the use of these tools," " I am not confident using these tools," "The tools are not reliable," and "I find the outputs to

be substandard to my liking." Furthermore, a teacher explained their occasional use of Grammarly was due to its high premium cost.

Third, respondents were asked about their general purpose of using ChatGPT by ticking what applies to them in a given list and how they incorporate ChatGPT in the classroom by supplying qualitative data. The modal response (36%) was using ChatGPT to learn concepts. About the same number of educators mentioned using ChatGPT for actual classroom instructions. This finding was corroborated by their qualitative replies to the question, "How do you incorporate ChatGPT in your classroom?" They cited: *"In actual instruction such as creating slides, outlines, syllabi, etc.,"* *"when doing instructional materials,"* and *"in generating simulation activities for students to do."* The language teachers specified "*creating syllabi for writing, reading comprehension, and vocabulary development"* and "*providing examples for composition in my Indonesian Television class."* Roughly 17% employ ChatGPT to create questions for their assessment activities. Again, this finding was substantiated by their qualitative answers. They cited: *"to create questions in my language classes," "to create review questions,"* and *"to generate multiple-choice questions for the students."* One respondent used it to reflect on their assessment practices*: "I compare my teacher-constructed questions with ChatGPT-constructed questions and see if students get higher scores in teacher-made or AI-generated questions. If my learners score higher when answering the AI's questions, as a teacher, I would ask myself: What are the features of the question that the AI made that could have appealed to my students?"* In addition, 15% of the surveyed educators mentioned using ChatGPT to "*write academic and research papers."* Eleven percent use ChatGPT to generate feedback on student outputs such as, *"when detecting the similarity index of written papers,*" and *"when checking the grammar, style, and mechanics of my students' essays."* Nine percent (9%) indicated *other* uses of ChatGPT beyond the options we listed. They use ChatGPT (1) to generate business correspondence, (2) to get suggested titles for created works, (3) to refine all types of written works, and (4) to have fun. Please see Fig. 9.
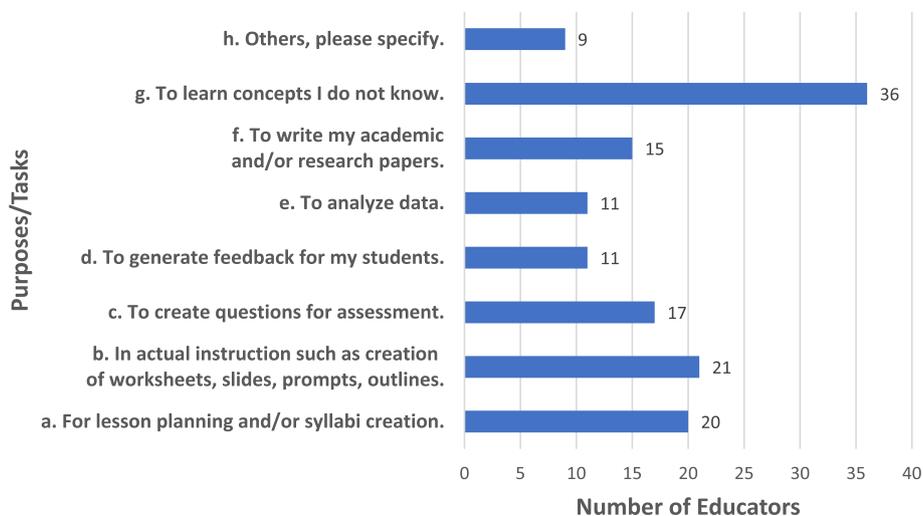

Fig. 9 Educators' purpose for using ChatGPT

Fourth, we asked the educators how they incorporate ChatGPT in research. Table 4 presents the 15 data-driven response categories extracted from the data, the overarching themes, examples of units segmented from the survey responses, and the frequency of their occurrences in our dataset. The themes and categories of responses in Table 4 show that ChatGPT assists educators in almost all stages of research writing—from ideation and conceptualization at the outset of research to the refinement of work to comply with the conventions of academic writing. Its top two uses are listing references and understanding concepts/generating ideas needed in doing research.

Fifth, we asked the educators for their general use of MTs. The most frequent (39%) reason for using MTs is for writing and replying to correspondences; this is followed

Table 4 Educators' responses to the question: How do you incorporate ChatGPT in your research?

Overarching Themes	Data-Driven Categories of Responses	Units (Examples from the survey responses)	F
Conceptualization and Ideation	Listing of related literature/references	*I use ChatGPT to efficiently look for references and sources*	10
	Understanding concepts and generating ideas	*If there are statements I need to be clarified about or I need some elaboration*	10
	Looking for an appropriate theoretical framework	*I use it to look for an excellent theoretical framework according to my research objectives*	3
	Identifying research gaps	*I use ChatGPT to generate research gaps*	2
	Creating research questions and hypotheses	*ChatGPT is a valuable platform that can assist educators in creating fresh research concepts or hypotheses from a specific set of keywords or ideas*	3
Writing and Manuscript Preparation:	Rephrasing and paraphrasing information	*I also ask ChatGPT to rephrase my draft*	5
	Complying with conventions of academic writing	*I use it to translate my writing into academic English* *Flow of writing* *For checking the tone of my writing*	4
	Comparing my written manuscript to the AI-generated one	*I compare the actual manuscript I've written and the AI-generated*	2
	Outlining content	*I ask it to draft me an outline of what to discuss in an introduction to discuss the background of the research*	1
	Writing manuscripts and proposals	*I use it in writing proposals* *It aided me when I was writing my thesis*	1
	Summarizing articles	*ChatGPT can turn articles into summaries*	1
Quality Control and Refinement	Grammar checking and refining outputs	*I used it to edit my outputs*	1
	Checking for plagiarized works	*I use it to check those who plagiarize and use ChatGPT to cheat*	1
Coding and Analysis:	Creating codes from scratch and examples of codes	*I asked it to explain how to create certain codes from scratch and give examples*	1
	Analyzing data	*I used the tool to assist in preliminary data analysis, unveiling trends and patterns that guide further inquiry*	1

by writing essays and reports (27%), preparing teaching and assessment materials (27%), and writing theses/dissertations/journal articles (17%). The *Others* category has 21 responses, including *"communicating with international students in making announcements in class," "understanding people and knowing what to say to people," "overcoming the language barrier in teaching Mathematics to Asians," and "learning a vocabulary word."* Please see Fig. 10.

Sixth, on the purposes of DWAs, a clear majority reported they use it for writing essays and reports (63%) and for writing theses/dissertations/journal articles (62%). Almost half of the educators (49%) utilize DWAs for writing and replying to correspondences. Nearly forty percent (38%) of educators use DWAs to prepare teaching and assessment materials, and 30% use DWAs to assess student outputs. The *Others* category indicated that the educators use it for revising other documents (6%). Please see Fig. 11.

Lastly, when we asked the purposes for which they use the APTs, the most frequent response is for writing essays and reports (39%); this is followed by writing theses/dissertations/journal articles (36%), replying to correspondences (28%), and preparing teaching and assessment materials (18%). The *Others* category responses were "*To create multiple social media content*" and "*To check its errors.*" Please see Fig. 12.
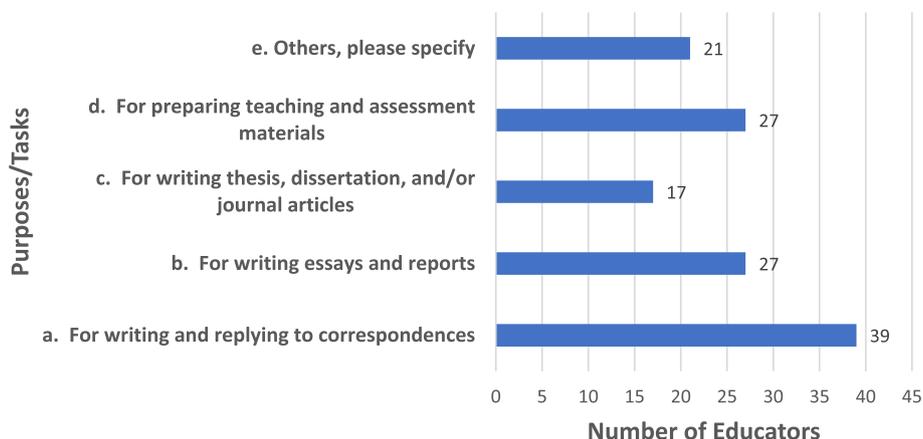

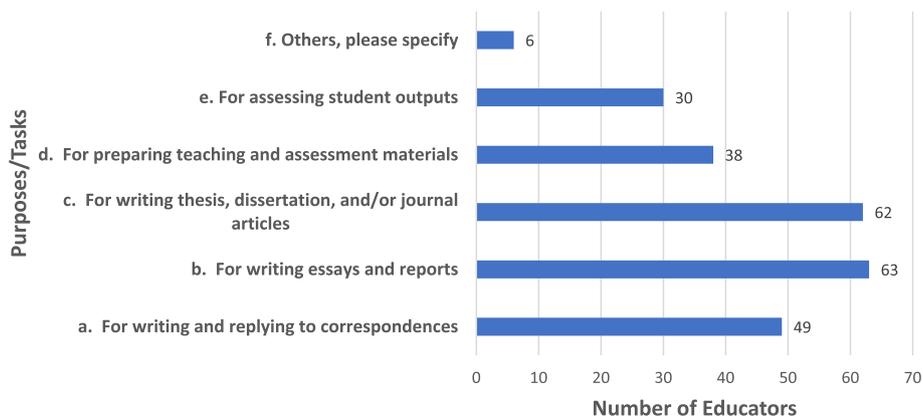**Fig. 10** Educators' Usage of Machine Translators (MTs)

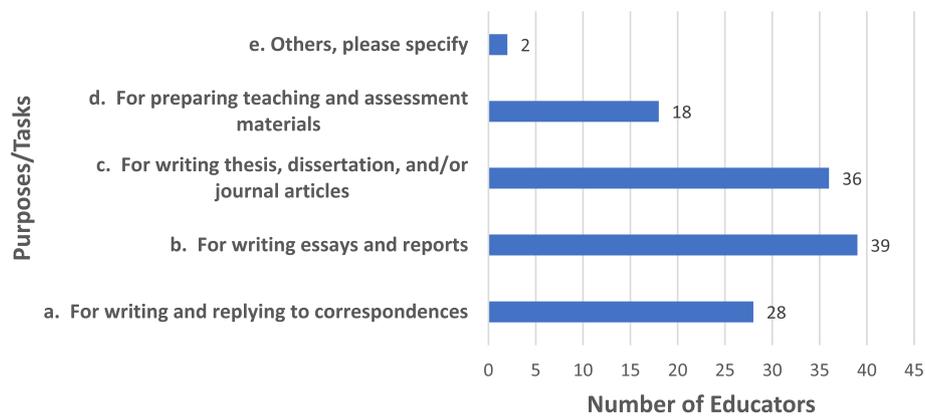**Fig. 11** Educators' Usage of Digital Writing Assistants (DWAs)

Fig. 12 Educators' Usage of Automated Paraphrasing Tools (APTs)

Part 3: Policies for the effective and ethical use of ADWTs

Part 3 analysis delved into the responses of the educators regarding the provision of policies in their respective institutions concerning the ethicality of these tools.

First, we asked whether their respective institutions have provided trainings for the effective and ethical use of the tools in question. A significant majority of 78 percent said they have not undergone training, while the rest (22%) have received such training. Again, this finding corroborates our previous finding in Part 1 (Perceptions) and Part 2 (Practices). Second, we asked if their institutions have provided guidelines for using the tools in question. An overwhelming majority of 96 percent said they do not have those guidelines; only four percent possess such guidelines.

Third, we asked if their institutions, at least, opened discussions that would lead to policy formation regarding the practical and ethical use of these tools. A minority of 28 percent claimed they had initiated such discussions, but a clear majority of 72 percent indicated they had not started such talks. Fourth, we asked if the educators, in their capacity, have provided guidelines for their students in the subjects they taught. Only 11 percent of the respondents provided guidelines, while the majority of 89 percent did not. Our thematic analysis of the respondents' qualitative replies on their classroom guidelines obtained the following themes. First, students can use the tools as long as they are aligned with responsible and ethical use, such as, *"require students to declare how they used AI," "sign an agreement to declare how they used AI,"* and *"remember to cite sources including the AI tools used."* Second, the allowable percentage of AI-generated content, such as, *"Turnitin detection should not be more than 10%"* and the *"domains or types of tasks in which AI tools can be used are specified."* Third, AI outputs should be evaluated, and their inaccurate results should be corrected, as stipulated by one respondent in her class:

> *Here are the basic guidelines I incorporate: (1) Read and analyze the patterns on how the AI tool wrote the concept; (2) Evaluate the accuracy of the content based on its context and applicability; (3) Improve or modify the content as necessary based on your own knowledge. (Respondent 5).*

In addition, submitted outputs must reflect the authors' thoughts *(e.g., "They can consult AI, but they should not copy the AI-generated content word for word. Their*

text should still be a product of their critical thinking"). Moreover, teachers are to be informed if their students use these tools *(e.g., "require students to inform me when they use these tools")*. Lastly, some respondents give strict guidelines: *"Failure to comply with the ethical and responsible use of the tools will result in a failing grade of the student in the course."* One respondent indicated*: "I make personalized instruction that any work (e.g., essays, short responses, etc.) that will be found AI-generated will be subject to revision. Once the student fails to revise the paper, it will be given a grade of zero or tantamount to plagiarized work."*

Lastly, we asked the participants to identify the resources or information on the ethical use of ADWTs they wish their institutions to provide. As seen in Table 5, we derived two overarching themes from our responses: (a) Ethical and effective use of AI, and (b) Equitable access to tools and information. To be able to use AI tools effectively in teaching, learning, and research within the boundaries of good ethical practices, respondents indicated that institutions should provide manuals or guidelines containing policies on acceptable use and deliver training to enable educators to maximize ADWTs' potential in assisting task performance. Moreover, the provision of AI tools to both educators and learners to ensure equitable access can foster a more inclusive learning environment. Equitable access also includes the sharing of best practices and case studies that narrate success stories on the use of AI in education and potential drawbacks.

Table 5 Resources teachers want their institutions to provide them

Overarching Themes	Data-driven Codes of Response Categories	Examples from Survey Responses	F
Ethical and Effective Use of AI	Manual/guidelines on effective and ethical use	*Manual on how to use and policies on how to regulate the use of Chat-GPT and other AI-powered tools Policy guidelines should be provided by institutions, subject to requisite consultations with different stakeholders*	46
	Training on the ethical and effective use of AI and support	*Training must be provided on how to maximize its utmost potential for teaching, learning, and research. Teachers and researchers should be trained on how to use these tools to assist them in their tasks*	22
Equitable access to tools and information	Provision of AI tools and Equitable access for both students and teachers	*Ensuring equitable access for faculty members, researchers, and students via institutional licenses or subscriptions fosters a more inclusive learning environment Many students cannot access it because we are from the poorest province of the poorest region in Luzon. If other students will use it and some cannot, it would be unfair to other students. Inequality in our university is prevalent*	8
	Sharing of Best practices and latest research in AI	*Sharing case studies, success stories, and the latest research on AI in education illuminates best practices and potential drawbacks*	2

It should be made clear at this point that inequalities in AI-integration are not the foci of the paper, but they are an interesting find from our results. The study by Brown (2022) explored the relationship between academic integrity and the digital divide that constrains equal access to technology. Decades ago, violations of academic integrity were typically exhibited by those with the unfair advantage of access, that is, students who have the means and resources to employ third-party services. But several AI-powered technologies, including ChatGPT and those that are embedded in mainstream word-processing tools, are now offered to the public for free. We recommend that this topic on the disparity in access to adequate information and communications technology facilities and infrastructure be a subject of future investigation.

Discussion

While the challenges and benefits of ADWTs and their implications for teaching, learning, and research in education have been discussed in the literature (Rudolph et al. 2023; Alshater 2022), only a few studies have asked educators' opinions regarding their perceptions, practices, and policies in using these tools (see Rahman & Watanobe 2023; Kim & Kim 2022). Previous theoretical and conceptual studies call for investigations that could produce empirical data regarding using AI-powered DWTs in education (Baskara & Mukarto 2023; Klimova et al. 2023; Roe et al. 2023). The current investigation is a response to such calls. Guided by the Technological Acceptance Model (TAM), this section discusses the three parts of our analyses: (1) Perceptions, (2) Practices, and (3) Policies.

Part 1. Educators' Perceptions regarding the utilization of ADWTs and their implications for academic integrity

Our first research question focuses on the educators' perceptions regarding the uses of these tools and their implications for academic integrity. Overall, our findings highlight the dual effects of AI integration in the educational landscape. On the one hand, the diverse applications of ADWTs in education maximize the productivity of those who embrace its affordances and have the skills and access to these tools. On the other hand, the ADWTs have negative impacts, which trigger under-utilization of ADWT's benefits. These findings substantiate the opportunities and threats reported in previous research (see Foltýnek et al. 2020; Kim & Kim 2022; Rahman & Watanobe 2023) regarding AI in education and empirically validates the theoretical perspective perpetuated by TAM that perceived ease of use and perceived usefulness dictate individuals' adoption and use of technology (Marikyan & Papagiannidis 2023). We now discuss how some of the antecedents of perceived usefulness and perceived ease of use in the TAM can explain our findings. In addition, we discuss the strategies educators perceived as ways to mitigate the perceived threats of AI adoption.

Perceptions about computer self-efficacy

In the technology acceptance model, computer self-efficacy captures the individuals' self-beliefs about technology and technology use (Venkatesh & Bala 2008). It is one of the antecedents of perceived ease of use. In the present study, it manifests in an

individual's confidence or lack of confidence in using ADWTs efficiently and effectively to perform the tasks. Such knowledge and skills are key enablers to maximize the productivity of those who embrace ADWTs' affordances in diverse educational applications. Our findings revealed that most educators have a neutral viewpoint regarding their skills, knowledge, and intentions in using the ADWTs. They lack confidence or belief in their technological competence. We interpret these in several ways: (1) educators lack exposure to ADWTs, (2) they are uncertain about the benefits of ADWTs in education, (3) they lack sufficient training to use ADWTs, (4) they have ambivalent feelings and concerns regarding the ethical use of ADWTs. Some of these offered interpretations have support from our data in Part 3 (Policies) and Part 2 (Practices), when teachers attested that "*We lack training in the use of these tools*" and "*I am not confident using these tools.*" This perception about computer self-efficacy is perhaps the reason why less than fifty percent of the educators did not or have not used ChatGPT, and they use the ADWTs under study only occasionally.

Perceptions about ADWTs's job relevance, results demonstrability, output quality, and external control

Our respondents are convinced of the benefits of these tools for their learning, teaching, assessment, and research, which confirm the positive effects of job relevance and results demonstrability—antecedents of perceived usefulness in TAM. However, mixed sentiments about output quality— the perception that relates to how the tools perform the individual's task well (Ventakesh and Davis 2000)—trigger educators to express concerns regarding the perils of these tools. Many of them doubt the quality of ADWTs's capability to generate reliable and accurate texts, confirming Bii et al.'s (2018) finding about educators' ambivalent feelings when the question of when to integrate chatbots into teaching is raised. These negative perceptions about output quality are compounded by their negative perceptions about external control, e.g., that they lack institutional support and guidelines to use the tools.

The educators' concerns regarding the threats of using these ADTWs have been discussed in previous research. Roe et al. (2023) raised concerns regarding textual plagiarism that may be committed using DWAs, MTs, and APTs. ChatGPT presents problems related to the reliability and accuracy of its content and issues related to academic integrity (Baskara & Mukarto 2023; Tlili et al. 2023). Chatgpteachers.net (2020) outlined seven categories of fear regarding ChatGPT. Rahman and Watanobe (2023) have empirical evidence from students and teachers regarding the threats of ChatGPT. They listed Integrity issues, Blind reliance on AI tools, Difficulty in evaluating the ChatGPT-generated answers and texts, Ethical implications and potential biases, and Critical thinking and problem-solving skill issues. All these concerns have been substantiated by our empirical data regarding the educators' concerns in integrating the mentioned ADWTS into teaching and research, confirming TAM's claim that perceptions of perceived ease of use (e.g., perceptions about output quality and external control) either limit or encourage the acceptance and utilization of technology.

Perceptions about the strategies to mitigate the threats of ADWTs

With the knowledge that the improper use of ADWTs may compromise academic integrity, two approaches in the integration of AI tools in education surfaced from our results: regulating or banning ChatGPT in various academic tasks. ChatGPT can be integrated with supervision in formative tests, essays, reports, and research-related tasks (thesis, dissertations, coursework research). However, ADWTs should be completely banned for summative tests, licensure examinations, qualifying tests, and all tasks involving mathematical calculations. Furthermore, for regulated tasks, we obtained data regarding the most favoured allowable percentage of AI-generated text in faculty and students' written outputs, which is 10 to 15 percent only, the acceptable percentage of text resemblance in most journals (Inkforall.com n.d.). Educators showed greater awareness regarding the perils these tools could engender if institutions were remiss in spreading awareness and regulating the use of these tools. They favour requiring students to report their use of ADWTs in graded performances but strongly oppose banning DWAs, MTs, and APs in graded written outputs. They also agree to the proposal to require faculty members to acknowledge using ChatGPT and other AI tools in their reports, research, and other performance tasks as expressions of academic integrity. Regulation, banning, and close supervision have also been recommended as strategies to mitigate the threats of ChatGPT in previous studies (see Rahman & Watanobe 2023 and Kalhan 2023). Overall, these rich empirical findings can be a valuable source of information for schools and universities trying to formulate institutional guidelines for integrating and regulating AI writing tools in education. These findings will also be our basis for creating a set of recommendations to safeguard established standards in teaching and research.

By and large, the identified educators' concerns may offer an explanation for why they have ambivalent reactions to these emerging technologies that revolutionize education. In addition to lack of training, support, and access to the efficient and ethical use of tools, these concerns prevent them from maximizing the tools. Previous research has established that teachers' perceptions and beliefs correlate with teachers' choices regarding technology integration for pedagogical purposes (Ertmer 2005; Wozney et al. 2006.) In fact, Russell et al. 2003 argue that the perceived affordances of technology for educational use may be the most vital factor of technology utilization in the classroom. As a teacher's evaluation of the tool's capacity to fulfil instructional purposes grows (job relevance) the probability of the tool being used also increases (Ottenbreit-Leftwich et al. 2010). In the current study, our teacher respondents appeared to have attached a high value for ADWTs' myriad ways to assist them and their students in their educational goals (perceived usefulness); however, they have to overcome their barrier threshold generated by their lack of access to these tools (perception of external control), perceived lack of knowledge on how to use these tools (computer self-efficacy), and perceived downsides about ADWTs that relate to academic integrity, creativity, and more (output quality).

Part 2. Educators' practices in using ADWTs

Our second research question delves into the educators' actual practices regarding their use of ADWTs. The discussion of findings is grouped under four topics: (1) Educators'

Scope and Frequency of integration of ADWTs, (2) Reasons for the unpopular use of ADWTs, (3) Integration of ADWTs in the teaching–learning process, (and 4) Integration of ADWTs in educational research.

Educators' scope and frequency of integration of ADWTs

We asked whether the educators employ these tools and the frequency of their usage. It has been revealed that the majority of respondents utilize Digital Writing Assistants (DWAs) like Grammarly, Machine Translations (MTs) such as Google Translate, and Automated Proofreading Tools (APTs). However, less than half of the educators use ChatGPT, indicating its lesser popularity. Regrettably, the usage of these tools by our respondents is only occasionally.

Reasons for the unpopular use of ADWTs

Despite the reported benefits of ADWTs, our findings revealed varying factors that hinder their full adoption of these tools. As a recent technological development, educators may not possess sufficient knowledge and skills to efficiently and effectively integrate ADWTs in the teaching–learning process, especially ChatGPT. Limited skills can create doubts about one's ability to utilize the tool in classroom teaching and in research—a factor that is within the domain of perceived ease of use in the TAM. Furthermore, the lack of institutional guidelines to reduce ethical concerns that the use of AI tools brings adds another barrier to the acceptance and use of these tools.

Integration of ADWTs in the teaching–learning process

Our application of the TAM in the present study assumes that the educators' perceptions regarding ADWTs' usefulness and ease of use influence the educators' use of ChatGPT, MTs, DWAs, and APTs to perform the range of tasks in the teaching and learning processes, from course conceptualization and development to content creation, assessment, and feedback (Horváth 2019). Our findings revealed that educators who embraced the ADWTs under study, as revealed in their current practices, use these tools to accentuate their productivity and make the teaching–learning process more efficient, echoing claims in previous literature (Rahman & Watanobe 2023).

Developing instructional materials is made more efficient through the assistance offered by ChatGPT. Hence, ChatGPT is viewed as an educational resource that aids in the professional development of educators as they receive unlimited explanations on various topics. It helps them intersperse work with fun as they engage in individualized conversation with ChatGPT. Educators also employed other ADWTs primarily for writing and replying to correspondences, for writing essays and research-related reports, for preparing teaching and assessment materials, for language teaching and assessment, and for checking other documents. These functions and purpose of use align with those reported in previous studies (see Baskara & Mukarto 2023; Klimova et al. 2023; Roe et al. 2023).

Integration of ADWTs in educational research

In the conduct of educational research, ADWTs have proven to be invaluable assistants. Chat GPT was utilized in all facets of educational research from ideation and

conceptualization to polishing of work, substantiating claims from previous studies that ADWTs can enhance research productivity in education (Mcreary 2019). Undoubtedly, its top use of listing references and clarifying concepts needed in doing research accentuates its usefulness in improving the research processes. Educators used ChatGPT to save time in planning, composing, and revising their written outputs.

Part 3. Policies for the effective and ethical use of ADWTs

Our third research question considered the policies and preparations provided by the educators for the appropriate and ethical use of the ADWTs in question. The discussion of findings in this part of the analysis is grouped under four topics: (1) Lack of institutional policies and training suggesting administrative lag, (2) Educators' desired institutional resources for ethical and effective use of ADWTs, and (3) Present study's corroboration of European Network for Academic Integrity's (ENAI) recommendations.

Lack of institutional policies and training suggesting administrative lag

Prior to asking the educators to write down their policy proposals for the effective and ethical use of ADWTs, they were asked if their institutions have provided them with policies, training, and support for AI integration in education. It is alarming that only a minority or less than one-third of the respondents attested that, at least, their institutions have already opened discussions regarding the need for structuring policies for the appropriate and ethical use of these tools. There is an evident lack of existing guidelines, training, and support for the ethical and effective adoption of AI tools as this finding keeps on surfacing in all three sections of our analyses. It can be taken to mean that, indeed, educators' perceptions translate to their actual practices and their proposed policies on the use of ADWTs in education. This finding suggests an administrative lag, indicating that institution heads may not be adequately informed or prepared to address the challenges of AI integration in education, particularly the issues concerning the responsible and ethical use of ADWTs.

Educators' desired institutional resources for the ethical and effective use of ADWTs

The educators in this study identified resources they wished their institutions would provide for the ethical use of ADWTs. Two overarching themes emerged: (a) Ethical and effective use of AI, and (b) Equitable access to tools and information. Respondents suggested that institutions should provide manuals or guidelines containing policies on acceptable use and deliver training to enable educators to maximize ADWTs' potential. They also called for equitable access to ADWTs for educators and learners to exemplify inclusive learning.

Educators cannot keep pace with the release of powerful ADWTs if this disturbing scenario continues. In the TAM framework, educators' perceptions of self-efficacy may lead to perceived ease of use, which can motivate technology adoption. This perspective emphasizes the need for educators to understand how to use AI tools in a manner that is both effective in achieving educational goals and ethical use by students and teachers. Rahman and Watanobe (2023) assert that diverse and well-balanced training is vital so that the use of ChatGPT is carefully considered since ChatGPT poses threats such as potential bias, privacy and data privacy issues, and unethical practices, and many more.

Lastly, a support system for knowledge sharing and continuous learning can help facilitate educators stay updated with the latest research and AI best practices. A support system encourages educators to learn from each other's experiences and to continuously adapt their methods and strategies as the field of AI evolves. On the other hand, some educators who realized the vast benefits arising from the use of ChatGPT and ADWTs in teaching and learning suggest ensuring all students and teachers, regardless of their background or resources, are provided equal access to these tools. This underscores the importance of providing AI tools and creating systems that allow for equitable access.

Present study's corroboration of ENAI recommendations

Our findings corroborate some of the recommendations made by the European Network for Academic Integrity (ENAI). ENAI is an international association that brings together educational stakeholders and acts as a gatekeeper of academic integrity. It issued recommendations for educational stakeholders to maximize the opportunities and familiarize them with the responsible use of ADWTs on acceptable academic integrity practices. ENAI advocates the need to equip all stakeholders with the necessary information and skills to address the encumbrances and benefits concerning AI-based tools used in education. Their recommendations include: acknowledging all persons, sources, and tools that influence a piece of work; accepting AI tools that do not generate content but only refine the form; taking responsibility by human authors and not making AI tools as co-authors; understanding that outputs generated by AI can be biased or incorrect; equipping students and teachers to appropriately use AI tools; training students and teachers on the ethical use of AI; providing national guidelines to direct institutions regarding responsible utilization of AI. ENAI recommends that institutions define when and how educational stakeholders can use AI in different academic tasks (see Foltýnek et al. 2020).

Recommendations

In this section, we focus on our recommendations for all stakeholders affected by the interface of AI integration in education based on the review of related literature and empirical evidence we collected from this study. First, we discuss four general principles: awareness, collaboration, empowerment, and educational reforms. Then, we offer specific recommendations for the ethical use of ADWTs in teaching, learning, assessment, and research.

Awareness

Educational institutions have long-established provisions that address academic misconduct. Formulating new or updating existing guidelines will be met with a never-ending race against rapid technological advancements (Eaton 2022). An alternative proposition is the promotion of the principles of academic integrity among stakeholders through an awareness campaign by properly educating and training various stakeholders on the multi-faceted forms of academic misconduct (Cotton et al. 2024). AI-ethical awareness campaigns can offer guidance, recommendations, and support regarding emerging questions of policy, which can be bases for classroom, departmental-level, or institutional policies. By doing this, students and educators will be sensitized in evaluating the ethical

dilemmas associated with the adoption of generative AI in accomplishing writing assignments (Elgersma 2023).

Collaboration

AI technologies are designed to mimic human abilities. While they seem to be performing better and faster than their human counterparts, the output from AI systems is not perfect, as attested by previous studies (Lim et al. 2023; Rahman & Watanobe 2023) current findings. Humans must remain in control of the learning task and exercise final judgment, such as in analyzing the similarity scores from plagiarism detection software (Eaton 2022; Hayden et al. 2021) and validating the information generated by the language models (Kim 2023). For instance, Grammarly generates suggestions for improving the written text, but the human author decides whether to accept the suggestions. The same situation can be seen in how email messages are composed; the predictive text feature attempts to guess the writer's intention by suggesting the following words or phrases, but the final decision rests with the writer (Waldron et al. 2017). Understanding these can help educators devise alternative pedagogical strategies to enhance students' writing quality by correctly applying ADWTs. Fostering a collaborative mindset by seeing AI tools as a collaborator rather than a competitor can yield better results and, perhaps, better proposals in responding to the current state of the issue on AI for students, educators, scholars, and organizations.

Empowerment

Holmes et al. (2021) point to a glaring inadequacy of literature that reports on agreed policies and regulations guiding the appropriate utilization of AI technologies in educational settings. One mechanism to address this is to look at student and teacher empowerment. For instance, educators can work with learners to establish acceptable classroom norms, codes of conduct, and commitments (Indiana n.d.; Stanford n.d.). Integrity should be infused as the core quality descriptive of this learning environment (Price-Mitchell 2015) that promotes a culture of ethical utilization of AI (Holmes et al. 2021). The basic principles comprising academic integrity, which include respect, responsibility, trustworthiness, fairness, and honesty should be taken into account when formulating guidelines that empower both educators and learners to take responsibility for their choices, to disclose their use of AI-powered tools (Gaggioli 2023), and to be held accountable for the consequences.

Empowerment may also be equated to providing equitable access to technology infrastructure to a larger percentage of learners. Our findings yielded some interesting sentiments about unequal access among our educators. While the question of how the presence of a digital divide may impact inclusivity in the use of ADWTs is not the primary focus of our study, this phenomenon would be an exciting investigation in future studies.

Educational reforms

Embracing AI technologies as part of the educational landscape calls for reforms on how educators and learners can perform their tasks to achieve educational goals in the era of AI. Foremost of these reforms is elevating the rigour of assessments (Lim et al. 2023)

by designing programs requiring more critical thinking (Zhai 2022; Cotton et al. 2024), emotional intelligence, reflective thinking, and experience to demonstrate that machine intelligence does not overpower human capabilities. In addition, Pavlik (2023) also noted that free access to large language models can lead to the "democratization of knowledge" that enables a larger population of stakeholders to benefit. It removes language barriers and reduces socioeconomic inequalities that hinder access to educational resources for the privileged few. Hence, institutions can benefit from the advantages of AI integration in education if it addresses problems associated with the digital divide.

However, the more important aspect of educational reforms that need prioritizing with reference to the main focus of this current study is the comprehensive overhaul of institutional policies that uphold academic integrity in the era of AI-powered technologies. Based on our empirical data, discussions on the practical and ethical use ADWTs in question have yet to be held in most institutions where the respondents of the current study are affiliated. In this regard, our respondents have enumerated some suggestions on the desired support their institutions can provide. We echo these recommendations as they are crucial in ensuring that both students and educators have the necessary skills to navigate these tools while exemplifying educational or academic integrity.

The emergence of possible misuse of digital writing tools, such as academic cheating, circumventing, or skipping some learning processes, prompts the need to regulate its use to safeguard acceptable educational practices. Consequently, teachers and school administrators need to take an active role in addressing these concerns by picking up their pace in creating relevant policies and guidelines for responsible, effective, and ethical use of these tools that are more educative than punitive (Bacha & Bahous 2010). Based on the study's results and literature review, we now recommend the following specific points to be considered in developing policies for the responsible and ethical use of ADWTs in teaching, learning, assessment, and research:

- ChatGPT and similar tools may not be allowed in licensure examinations that measure candidates' competence in a specific field or profession. Likewise, these tools should not be permitted in qualifying examinations that measure candidates' aptitude and eligibility to advance to higher stages of education. The use of ChatGPT has already been regulated in some educational institutions (Kalhan 2023).
- Allow some generative tools to assist classroom-related writing, but this must be clearly credited by the author (Roe et al. 2023). Consider making AI-generated content as part of the supplemental data or appendix display. Check the latest guidelines of the citation and formatting style you use to cite AI tools. In writing scientific articles and business communication, as much as possible, specify which part of the work is generated or influenced by ADWTs (Buriak et al. 2023; Foltýnek et al. 2020) for transparency and accountability in the acknowledgement, introduction, or methods section.
- Classroom teachers/instructors should ensure that students understand the risks of unwittingly or intentionally using tools to make others' ideas their own (Roe et al. 2023).
- Strengthen stakeholders' grip on the values of academic integrity so that all uses of ADWTs to maximize learning follow academic integrity standards (Foltýnek et al.

2020). It includes training teachers on how to teach students the proper and ethical use of ADWTs (Cotton et al. 2024).

- Develop and implement applicable policies to maximize the opportunities for learning based on the learners' contexts and program goals and address the challenges posed by using ADWTs (Foltýnek et al. 2020; Cotton et al. 2024).
- Teachers may use tools and strategies such as Turnitin, Copyleaks, stylometric analysis metadata analysis, GPT-2 detector, GPTZero, GPTRadar, and PlagiBot. Although these tools have some limitations, using a combination of these may be necessary in conjunction with human judgment and critical review to detect AI-generated content (Uzun 2023).
- Exercise caution in using ADWTs in language assessment by considering the assessment's goals, measured proficiency level, and access to the tools. For example, proper use of ADWTs that only refine the form (e.g., spelling checkers, thesaurus, Grammarly, and the like) should be generally acceptable (Foltýnek et al. 2020). Learners can benefit from such tools during formative assessments or ungraded practice exercises. However, in summative testing that aims to measure language proficiency, allowing the ADWTs may forfeit the assessment's goal. Hence, assessing students' skills without AI tools might prove beneficial.
- ChatGPT outputs cannot be taken at face value. Research outputs must be reviewed critically to prevent errors, incorrect or missing key information, or nonsensical and unrelated claims (Buriak et al. 2023; Rahman & Watanobe 2023).
- Do not copy ChatGPT's outputs verbatim. Treat them as early drafts that need to be checked and considered critically. It may only be used to expand and spark new ideas and not an end in itself (Buriak et al. 2023; Rahman & Watanobe 2023).
- Citations from ChatGPT need to be verified from their source (Buriak et al. 2023). Likewise, data analyzed by ChatGPT needs to be evaluated as ChatGPT is known for fabricating unreliable, biased, and inaccurate information (Rahman & Watanobe 2023)

In summary, the recommendations for ADWTs' integration into education are based on four principles: awareness, collaboration, empowerment, and educational reforms. Awareness campaigns should educate stakeholders about academic misconduct and the ethical dilemmas of using ADWTs in writing assignments. Collaboration involves teachers, technical support staff, and students to develop the ability to harness ADWTs' power effectively and ethically. This recommendation includes being critical in sieving out unreliable or unfounded ideas generated by ADWTs. It emphasizes human control over AI systems, with ADWTs seen as collaborators rather than competitors, adopting Ouyang and Jiao's (2021) proposed human-centric approaches in utilizing AI in education: AI-supported (i.e., the user collaborates with AI to perform the task) and AI-empowered (i.e., the learner exercises control over their learning). Empowering teachers involves establishing classroom governance that promotes the ethical use of ADWTs and providing equitable access to technology. Lastly, introducing educational reforms involves innovative teaching and assessments that could showcase human intelligence over ADWTs or partnership with ADWTs. Since academic integrity is the principle that guides the ethical conduct of educational stakeholders, any use of a technology that

could aid student learning must be in keeping with its key aspects which are vital in upholding the integrity and credibility of the educational processes and outcomes necessary for maintaining trust, respect, accountability, fairness and equity, and quality of education (Fishman 2014; Gottardello & Karabag 2022).

Study limitations and suggestions for future research

Due to the nature of the snowball sampling method with limited participants, the study's results are not generalizable to the greater population. Disciplinary bias could be present due to an uneven distribution of participants across different disciplines. The limited sampling can be attributed to the early stages of the utilization of ADWTs in the Philippines where education has been challenged by the lack of technology infrastructures such as access to the internet and ADWTs. Moreover, the study only utilized a cross-sectional survey where many of the respondents admitted they had not used and were unfamiliar with the ADWTs at the time the study was conducted such that they have not contributed much to the discussions regarding actual ADWTs integration in their courses taught. In addition, inductive thematic analysis can be subject to the bias of human coders despite efforts to ensure inter-coder reliability and cross-validation approach using AI and human coders. Finally, the study might not have captured all nuances or emerging trends in educators' perceptions, practices, and policies, given the complexity of issues surrounding ADWTs and academic integrity.

   We now suggest some topics for future investigation. It will be interesting to know if using ADWTs among secondary and tertiary students has become a norm, mainly since they belong to the younger generation, who are more adept with technology than their teacher counterparts. Specifically, Roe et al. (2023) suggested that research be conducted to understand whether students are aware of the ethical issues and why and how students use each of the tools (e.g., MTs, DWAs, and APTs). A classroom-based or action research may be conducted in this regard. Likewise, it will be noteworthy to delve deeper into how ChatGPT could impact teaching and learning in disciplines such as Mathematics and Science. In addition, a contrastive text analysis of AI-produced texts and human-produced texts can prove beneficial to better the performance of ADWTs or to better distinguish the features of AI-generated text vis-a-vis human-generated text. Additionally, a more in-depth study on the various strategies educators and students employ to mitigate threats of using ADWTs in various specific disciplines and tasks may be conducted to document the nuances and intricacies in these unique contexts as these tools are constantly being improved. Lastly, we need more research to document the development of new tools such as AI-powered plagiarism tools to safeguard the integrity of academic teaching and research.

Conclusion

AI technologies are here to stay. They are speedily making headway in education and are projected to increase more swiftly (Zhang & Aslan 2021). According to Munde (2023), AI in the Education market industry's compound annual growth rate (CAGR) is projected at 38% during the predicted period (2023–2030). Clearly, more educational institutions now employ these tools because of their proven and potential benefits for teaching, learning, and research, substantiating Davis' (1989) TAM's claim that perceived

usefulness triggers technology users to accept and utilise new technologies. This present study gleaned deeper insights into TAM's and other previous studies' claims regarding the centrality of perceptions in influencing the educators' adoption of AI in education (Ertmer 2005; Wozney et al. 2006).

However, this present study has also uncovered that educators' perceptions of ADWTs in education encompass both positive and negative sentiments. These mixed sentiments may have influenced their acceptance or hesitation in integrating the technologies into their actual education and research practices. On the one hand, their positive perceptions can be explained by the antecedents of perceived usefulness in the TAM's model, job relevance and results demonstrability, because the educators recognize the benefits of ADWTs in their jobs with tangible results such as enhancing teaching–learning outcomes, automating tasks, thereby increasing higher levels of productivity and efficiency. On the other hand, their fears, which refrain them from adopting or fully utilizing the ADWTs can be explained by the following: (1) perceptions regarding the unavailability of organizational and technical resources to guide and support them (Perception of external control); (2) perceptions regarding academic integrity/ethical issues that may result in poor quality (output quality); and (3) perceptions about their self-beliefs relating to their lack of training, access, and familiarity with ADTWs (computer efficacy).

AI in education, in particular, ADWTs, calls for critical awareness of ethical protocols and requires collaborative efforts by AI experts, researchers, and educators to initiate extensive, longitudinal research (Zhang & Aslan 2021) that could generate more ethical guidelines for all stakeholders and spur new transformations and possibilities in education. Perhaps, research in the opportunities and threats of ADWTs, although requiring more empirical studies, has already reached its maturity. What we need is more research on the strategies that can mitigate the threats of AI invasion in the human world so that we can utilize this good crisis happening in the educational landscape.

Appendix 1

Sample N-gram Analysis for the dataset: How to incorporate Chat GPT in research.

The text provided is a compilation of various statements and experiences of individuals using ChatGPT for different purposes. Here are some identified n-grams (sequences of words) in the text:

1. Bigrams:—"ChatGPT to"—"I use"—"to rephrase"—"research article(s)"—"grammar checking"—"thesis statements"—"reading lists"—"data analysis"—"academic English"—"Python codes"—"research gap"—"key words"—"flow of"—"writing flow"—"Microsoft Bing".
2. Trigrams:—"I use ChatGPT"—"ask ChatGPT to"—"related to my"—"for my research"—"in the context"—"research from scratch"—"ask it to"—"to discuss in"—"create certain codes"—"to rephrase my"—"find a list"—"refer to the"—"use it to"—"look for references"—"check those who".
3. Fourgrams:—"I use ChatGPT to"—"to rephrase or paraphrase"—"related to my research"—"I ask it to"—"ask it to draft"—"to create certain codes"—"need to rephrase

my"—"to look up possible"—"to efficiently look for"—"look for references and"—"use it to scour"—"I asks for reference".

4. Fivegrams:—"I use ChatGPT for research"—"ask it to draft me"—"to create certain codes from"—"need to rephrase my long"—"to look up possible questions"—"efficiently look for references and"—"look for references and sources"—"use it to scour for".

These n-grams represent common phrases or sequences of words that appear in the text. They provide insight into the main themes and topics discussed, such as using ChatGPT for research, asking it for help with various tasks, and the process of looking for references and sources.

Appendix 2

Sample coding by human inter-coders for the dataset: How to incorporate Chat GPT in research (with cross-validation from Discourse Analyzer)

Raw Data (Responses to the question: HOW DO YOU INCORPORATE CHATGPT IN YOUR RESEARCH	Codes by Coder 1	Validation of Codes by Coder 2	Settlement of codes by Coder 3 if there are disagreements between Coder 1 and 2	Final Codes	Cross-validation with AI codes (Exact codes generated by Discourse Analyzer)
I ask ChatGPT to show me literature about the topic; I also asked GPT to write an introduction for my articles so that I can compare mine with the output of ChatGPT	Listing of related literature on the topic Writing introduction and comparing it with AI output	Listing of related literature on the topic Writing introduction and comparing it with AI output		Listing of related literature on the topic Compare AI-written introduction to an article versus human output	Reference Generation Drafting Research Outlines
I only use it for things I am not quite familiar yet, so it is merely for concepts/ideas	Understanding concepts	Understanding Concepts		Understanding concepts	Understanding Complex Topics
When doing research, when need to rephrase or paraphrase the information	Rephrasing and paraphrasing information	Rephrasing and paraphrasing information		Rephrasing and paraphrasing information	Rephrasing and paraphrasing information
In writing the manuscripts and proposals	Manuscript and Proposal Writing	Manuscript and Proposal Writing		Manuscript and Proposal Writing	Manuscript and Proposal Writing
By asking chatGPT to suggest related literature in my studies	Listing of related literature	Listing of related literature		Listing of related literature	Reference Generation

Raw Data (Responses to the question: HOW DO YOU INCORPORATE CHATGPT IN YOUR RESEARCH	Codes by Coder 1	Validation of Codes by Coder 2	Settlement of codes by Coder 3 if there are disagreements between Coder 1 and 2	Final Codes	Cross-validation with AI codes (Exact codes generated by Discourse Analyzer)
With regards to research, I am asking for possible research article(s) that is/are related to the subject matter I feed to ChatGPT. It provide recommendations including the sources Sometimes, I also ask it to recommend a theory that can be associated with a certain idea. Then, I explore the theory by reading articles related to it to validate its appropriateness to the context	Listing of related literature Suggesting a Theory	Listing of related literature Suggesting a Theory		Listing of related literature Suggesting a Theory	Reference Generation Theory Recommendation
Utilizing ChatGPT as a brainstorming instrument, researchers can generate innovative research questions, hypotheses, and directions, fostering groundbreaking projects Moreover, the tool can assist in preliminary data analysis, unveiling trends and patterns that guide further inquiry Conference preparation is facilitated by ChatGPT's capacity to generate talking points and presentation materials, ensuring effective communication of one's work	Brainstorming to generate RQs, hypothesis, etc Preliminary data analysis Generating talking points and presentation materials for conference	Isn't this the same as soliciting ideas? The green highlighted font are some ideas that could be solicited? Preliminary data analysis How is this different from the previous codes? Aren't talking points "ideas and concepts"?	Brainstorming to generate RQs, hypothesis, etc Conference preparation	Brainstorming to generate RQs, hypothesis, etc Preliminary data analysis Conference preparation	Brainstorming Research Questions and Hypotheses Preliminary Data Analysis Conference Preparation

Raw Data (Responses to the question: HOW DO YOU INCORPORATE CHATGPT IN YOUR RESEARCH	Codes by Coder 1	Validation of Codes by Coder 2	Settlement of codes by Coder 3 if there are disagreements between Coder 1 and 2	Final Codes	Cross-validation with AI codes (Exact codes generated by Discourse Analyzer)
If there are statements I need to be clarified about or I need some elaboration	Clarifying statements	Clarifying statements		Clarifying statements	Clarification and Elaboration

Appendix 3

Sample Codes Created by Discourse Analyzer for the dataset: How to incorporate Chat GPT in research.

1. Use of ChatGPT for Literature Review
2. Use of ChatGPT for Writing Assistance
3.   Use of ChatGPT for Research Ideas and Concepts
4. Use of ChatGPT for Paraphrasing and Rephrasing
5. Use of ChatGPT for Manuscript and Proposal Writing
6. Use of ChatGPT for Theory Recommendation
7. Use of ChatGPT for Grammar Checking and Tone Analysis
8. Use of ChatGPT for Thesis Brainstorming
9. Use of ChatGPT for Article Collation
10. Use of ChatGPT for Conceptual Guidance
11. Avoidance of Plagiarism with ChatGPT
12. Use of ChatGPT for Research Framework Suggestions
13. Use of ChatGPT for Brainstorming Research Questions and Hypotheses
14. Use of ChatGPT for Preliminary Data Analysis
15. Use of ChatGPT for Conference Preparation
16. Use of ChatGPT for Clarification and Elaboration
17. Use of ChatGPT for Translation into Academic English
18. Use of ChatGPT for Drafting Research Outlines
19. Use of ChatGPT for Coding Assistance
20. Use of ChatGPT for Reference Generation
21. Use of ChatGPT for Research Gap Identification
22. Use of ChatGPT for Problem Formulation
23. Use of ChatGPT for Keyword Search
24. Use of ChatGPT for Concept Finding
25. Use of ChatGPT for Improving Writing Flow
26. Use of ChatGPT for Initial Information Scouring
27. Use of Other Platforms (e.g., Microsoft Bing) in Conjunction with ChatGPT
28. Use of ChatGPT for Understanding Complex Topics

Abbreviations

ADWTs	Algorithmically-Driven Writing Tools
AI-DWTs	AI-powered Digital Writing Tools
MTs	Machine Translators
DWAs	Digital Writing Assistants
APTs	Automated Paraphrasing Tools
LLMs	Large Language Models
AI	Artificial Intelligence
NLP	Natural Language Processing

Authors' contributions

The initial conceptualization of the study was made by Gustilo and Ong. The design of the instruments was a collaborative effort among the authors who brought in ideas from their respective fields of research. All three authors were also involved in collecting data from the respondents. Bulk of the work in analyzing the survey data and writing the Results and Discussion sections were done by Gustilo, with Lapinid handling the statistical analysis and presentation of results in tables and figures. Gustilo and Lapinid also wrote the Methodology and the Conclusion sections. Setting the tone of the research work (Introduction) supported by relevant literature was done by Ong. The recommendations were a joint effort among all the authors. Most of the reference entries were prepared by Ong. All three authors were involved in revising the different parts of the paper. Language editing and formatting were done by Gustilo, and the approval of the final manuscript was made by all authors.

Author's information

Leah Gustilo is Full Professor in the Department of English and Applied Linguistics, De La Salle University. She is the Founding Chief Editor of Journal of English and Applied Linguistics (launched in June 2022) and Modern Journal of Studies in English Language Teaching and Literature (launched in December 2019). She has been involved in several research projects funded by the British Council, Fund to Assistance for Private Education, Japan International Cooperation Agency Philippines, Knowledge Channel Foundation Inc., and University Research Coordination Office of De La Salle University. She has presented her research works in conferences in Asia, USA, and Europe. She has served in different positions as a Linguistic Society of the Philippines board member: Director of Publications and Associate Editor (2016–2018), Vice President (2018–2020), Director of Conferences (2020–2021), and Director of Publications (2021-April 2023).

Ethel Ong is Full Professor of the College of Computer Studies at De La Salle University – Manila. A Senior Researcher for the University's Center for Language Technologies, she develops automated story generation systems and narrative-based conversational interfaces with applications in learning and healthcare. She has received government-funded grants from DOST-PCIEERD for her research "***Enhancing Man–Machine Interaction through Intelligent Conversational Agents,***" and UNICEF Philippines to conduct "***A National Study on Online Sexual Abuse and Exploitation of Children in the Philippines***". She regularly delivers capacity training on research writing, research ethics, and computational storytelling.

Minie Rose Lapinid is Associate Professor of the Department of Science Education at De La Salle University—Philippines. She was formerly the Research and Advanced Studies director of the College of Education, Chairperson of the Department of Science Education, the Treasurer and a Board member of the Philippine Council of Mathematics Teacher Educators (MATHTED), Inc. She is currently the Assistant Secretary and a Board Member of Division 1 of the National Research Council of the Philippines and the Vice President and a Board Member of MATHTED. Her main research interests are in the areas of mathematics education and service learning. She has been part of research projects that are externally funded by local and international agencies.

Availability of data and materials

We are bound by ethics to safeguard the raw data we collected from our respondents. The results we presented in our paper provide a synthesis of the data from which we drew our analysis and recommendations. Portions of the research instruments can also be seen in the different parts of our paper. However, the materials we used in data collection and other data are available upon request.

Declarations

Competing interests

None.

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