Library Progress International
Vol.44 No. 3, Jul-Dec 2024: P.1742-1755

Print version ISSN 0970 1052
Online version ISSN 2320 317X

Original Article

Available online at www.bpasjournals.com

Awareness and Utilization of AI-Powered Referencing Tools and Research Engines among Science Teachers: An Analysis through the Technology Acceptance Model

Cinder Dianne L. Tabiolo[1], Betcieva G. Rada[2], Maria Concepcion L. Temblor[3], Dennis O. Polinar[4], and Airene D. Rosete[5]

[1]Professor, Jose Rizal Memorial State University-Dipolog Campus
[2]Assistant Professor, Romblon State University-San Fernando Campus
[3]Assistant Professor, Cebu Technological University - Moalboal Campus
[4]Instructor, Bohol Island State University - Bilar Campus
[5]Assistant Professor, University Laboratory School-University of Southern Mindanao
[1]cinderdiannetabiolo@jrmsu.edu.ph, [2]queendrethmhaey17@yahoo.com, [3]mariaconcepcion.temblor@ctu.edu.ph, [4]zed990998@gmail.com and [5]adrosete@usm.edu.ph

How to cite this article: Cinder Dianne L. Tabiolo, Betcieva G. Rada, Maria Concepcion L. Temblor, Dennis O. Polinar, Airene D. Rosete (2024). Awareness and Utilization of AI-Powered Referencing Tools and Research Engines among Science Teachers: An Analysis through the Technology Acceptance Model. *Library Progress International,* 44(3), 1742-1755.

ABSTRACT

The rapid advancement of artificial intelligence (AI) has led to the development of AI-powered referencing tools that enhance academic writing and research processes. This study explores the awareness and utilization of these tools among 71 randomly sampled science educators in two selected higher education institutions in the Philippines. Results revealed Google Scholar and Semantic Scholar are the most popular AI referencing and search engine tools, science educators generally have a positive perception of AI-powered referencing tools, particularly regarding their usefulness and the benefits they offer in enhancing academic referencing. However, there are usability challenges that need to be addressed, as mixed responses regarding ease of use indicate room for improvement in user experience. Gender differences in perceptions of usefulness and ease of use were noted, but both male and female educators ultimately shared similar attitudes and usage patterns once engaged with the tools. The uniform acceptance across age groups further suggests that these tools are widely valued, with strong correlations between ease of use, attitude, and actual usage reinforcing the critical role of user-friendly design in technology adoption. The findings imply that integrating user-friendly AI-powered referencing tools into science education can enhance academic writing efficiency, while highlighting the need for continuous improvement and consideration of diverse user experiences in both practice and theoretical frameworks of educational technology adoption.

KEYWORDS

AI-powered referencing tools, Science educators, Higher education, Mixed-methods research, Academic writing

1. INTRODUCTION

In a global context, the adoption of AI-powered referencing tools varies significantly across regions and disciplines (Alharbi, 2023, Cardon et al, 2023). While some educators and institutions have fully embraced these technologies, others remain hesitant due to concerns about reliability, accessibility, and the learning curve associated with new software (Wang, et al, 2023, Yeo, 2023). This disparity highlights the importance of understanding the specific factors that influence the awareness and utilization of these tools, particularly in regions where digital literacy and access to technology may be uneven.

The integration of artificial intelligence (AI) into various facets of education is transforming how educators and researchers approach academic tasks. In the realm of science education, where accuracy, rigor, and efficiency are paramount, AI-powered tools are becoming increasingly essential. Among these innovations are AI-powered referencing tools, which automate and enhance the process of managing citations and bibliographies—critical components of academic writing and research (Kim & Kim, 2022, Cooper, 2023).

As science educators strive to keep pace with the evolving demands of research and teaching, the adoption of AI-driven technologies offers the potential to alleviate the burdens associated with traditional referencing methods. These tools not only reduce the time spent on manual citation management but also improve the accuracy and consistency of references, thereby enhancing the overall quality of academic outputs (Nazaretsky, et al, 2022, Owan et al, 2023). However, the effectiveness of these tools is contingent on their awareness and utilization among educators (Rad et al, 2022, Llaneza & Magulod, 2023, Cooper, 2023).

Theoretical Framework

The Technology Acceptance Model (TAM), originally developed by Davis in 1989, serves as the foundational theoretical framework for this study, providing insights into how and why science educators adopt or resist AI-powered referencing tools (Balakrishnan et al, 2024, Lin & Xu, 2022, Na et al, 2022, Sharma et al, 2024).

As shown in the Figure 1, TAM posits that the acceptance and usage of technology are primarily determined by two key factors: perceived usefulness (PU) and perceived ease of use (PEOU). Perceived usefulness refers to the degree to which a person believes that using a particular technology will enhance their job performance, while perceived ease of use reflects the extent to which a person believes that using the technology will be free of effort.

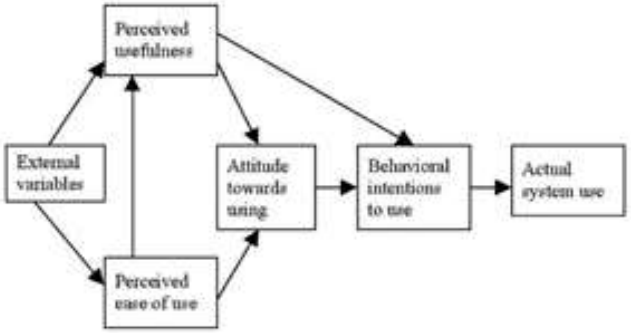

Figure 1. Technology Acceptance Model (TAM) (Davis, 1989).

In the context of this study, TAM is particularly relevant as it helps to elucidate the factors that influence the awareness and utilization of AI-powered referencing tools among science educators. The literature indicates that while AI-powered tools have the potential to greatly improve academic productivity by automating tedious tasks such as citation management, their adoption is not yet widespread due to varying levels of digital literacy and technology apprehension among educators (Choung, David & Ross, 2023, Al-Adwan et al, 2023, Zhang et al, 2023, Liu & Ma, 2024).

Studies have shown that educators are more likely to adopt new technologies when they perceive them to be both useful in enhancing their academic output and easy to integrate into their existing workflows (Choi, Jang & Kim, 2023, Du & Gao, 2022, Al Darayseh, 2023, Arguson, Mabborang & Paculanan, 2023). However, barriers such as unfamiliarity with AI technology, concerns over reliability, and the steep learning curve associated with new tools often hinder their acceptance (Kim & Kim, 2022, Alharbi, 2023, Chounta et al, 2022; Talreja & Agashe, 2024; Sachdeva et al., 2024).

By applying TAM, this study seeks to analyze the underlying attitudes and beliefs that shape the adoption behavior of science educators, with a focus on identifying how perceived usefulness and ease of use can be enhanced through targeted training and support. Understanding these dynamics is crucial for developing strategies that can bridge the gap between awareness and utilization, ultimately leading to more widespread adoption of AI-powered referencing tools in science education and improving the quality of academic research and teaching.

Philippine Context

In the Philippines, the integration of AI-powered referencing tools into higher education is particularly relevant given the growing emphasis on enhancing research quality and academic productivity (Bantoto et al, 2024, Santiago et al, 2023, Espartinez, 2024, Junio & Bandala, 20230). Science educators, operating in a diverse educational landscape characterized by varying levels of digital infrastructure and resources, face unique challenges and opportunities in adopting these technologies. The Philippine higher education sector is increasingly recognizing the need for innovation to keep pace with global standards, but there are significant disparities in access to and familiarity with advanced digital tools among institutions.

Many universities in the Philippines are investing in digital transformation to improve educational outcomes, yet the adoption of specialized AI-powered tools for academic tasks like referencing remains inconsistent. Factors such as limited access to high-quality internet, varied levels of technological proficiency among educators, and

insufficient training programs contribute to the uneven uptake of these tools (Villarino & Vilarino, 2024, Garcia, 2024). Additionally, there is a cultural and infrastructural lag in integrating new technologies into traditional academic practices, which can hinder the effective use of AI tools.

Role of Science Educators in Advancing Research and Teaching

Science educators, who play a critical role in advancing research and teaching in the STEM fields, can greatly benefit from AI-powered referencing tools. These tools offer potential improvements in citation accuracy, research efficiency, and academic writing quality, aligning with national educational goals to enhance research output and international competitiveness (Al Darayseh, 2023, Almasri, 2024, Galindo-Diminguez et al, 2024, Al-Abdullatif, 2023). However, addressing the barriers to adoption—such as lack of training, concerns about tool reliability, and resistance to change—requires targeted interventions. By focusing on increasing awareness and providing support, the Philippine higher education sector can better harness the benefits of AI technologies, ultimately contributing to the advancement of science education and research in the country.

Research Gap

Despite the growing importance of AI-powered referencing tools in enhancing academic efficiency and accuracy, there is a notable research gap regarding their adoption among science educators in the Philippines. While the global literature emphasizes the potential of AI technologies to streamline academic tasks and improve research quality, studies specifically focusing on the context of Filipino higher education remain scarce. Existing research often highlights general challenges such as digital literacy and technology acceptance but lacks detailed insights into how these factors influence the specific use of AI-powered referencing tools within the unique educational and infrastructural context of the Philippines (Leung et al, 2023, Hueber & Kleyer, 2023).

For instance, Davis et al. (1989) and Na, Heo Shin and Roh (2022) provide foundational insights into the Technology Acceptance Model (TAM), but they do not fully address the nuanced barriers faced by educators in developing countries. This study aims to bridge this gap by examining the awareness, utilization, and perceived challenges of AI-powered referencing tools among Filipino science educators, thus contributing valuable context-specific insights to the existing body of knowledge on technology adoption in education.

Practical Problems Experienced in the University

In the university setting, Filipino science educators face several practical problems in integrating AI-powered referencing tools into their academic workflows. One significant issue is the inconsistent access to reliable internet, which hampers the effective use of cloud-based AI tools and limits their functionality.

Additionally, many educators struggle with varying levels of digital literacy, resulting in difficulties navigating and utilizing these advanced technologies. This lack of familiarity with AI tools often leads to skepticism about their reliability and effectiveness. Moreover, the absence of comprehensive training programs exacerbates these challenges, as educators lack the necessary support to fully understand and leverage the benefits of AI-powered referencing tools. These practical problems collectively contribute to the slow adoption of these technologies, impacting the overall efficiency and quality of academic writing and research within the university. Addressing these issues through targeted infrastructure improvements and educational initiatives is crucial for facilitating smoother integration and enhancing the academic productivity of science educators.

This study focuses on Filipino science educators in higher education, exploring their awareness and utilization of AI-powered referencing tools. By examining the quantitative aspect of their experiences, this research aims to identify the challenges and opportunities associated with integrating AI technologies into the academic practices of science educators. The findings of this study have broader implications for the global adoption of AI in education, particularly in enhancing the efficiency and quality of academic research and teaching in science.

Implications for Science Education

The implications of this study for science education are substantial, highlighting the critical role that AI-powered referencing tools can play in enhancing the efficiency and quality of academic practices among science teachers. Integrating these tools into science education can significantly streamline the process of managing citations and bibliographies, allowing educators to focus more on developing innovative teaching methods and engaging with cutting-edge research. By automating routine tasks associated with academic writing, AI-powered tools can reduce the cognitive load on educators, leading to more accurate and consistent references, which, in turn, improves the overall quality of scientific research and publications. Moreover, the adoption of these tools can foster a more research-oriented culture among science educators, promoting a deeper engagement with contemporary scientific discourse and contributing to the advancement of the STEM fields. Ensuring that science educators are equipped with the skills and resources to effectively utilize AI-powered referencing tools is essential for maximizing their potential benefits, ultimately enhancing the quality of science education and research outcomes.

This study investigates the awareness and utilization of AI-powered referencing tools among Filipino science

educators in higher education, focusing on the challenges and opportunities within the Philippine academic context. As AI technologies advance, tools designed to streamline citation management and improve academic writing are increasingly available, yet their adoption remains uneven.

Despite a general awareness of AI-powered referencing tools, utilization remains low due to unfamiliarity and concerns about reliability. The findings emphasize the need for targeted training to enhance both awareness and effective use, aiming to bridge the gap between knowledge and practical application. By addressing these issues, the study seeks to improve the efficiency and quality of academic research and teaching in science, aligning with broader goals of advancing educational practices in the Philippines.

2. OBJECTIVES

The study geared to evaluate the perceived usefulness, ease of use, attitude toward, and behavioral intention to use AI-powered referencing tools among Filipino science educators. It seeks to identify how these factors relate to the actual use of these tools and to explore any differences in technology acceptance based on demographic variables such as sex and age. Specifically, the study aimed to: (1) To assess the technology acceptance of AI-powered referencing tools among Filipino science educators; (2) To examine differences in technology acceptance based on demographic variables such as sex and age; (3) To determine the relationship between these factors and actual use of AI-powered referencing tools.

3. HYPOTHESES

This study tested three research hypotheses in null form: (*1) H_{01}: There is no significant difference in the technology acceptance of AI-powered referencing tools among Filipino science educators based on demographic variables such as sex; (2) H_{02}: There is no significant difference in the technology acceptance of AI-powered referencing tools among Filipino science educators based on age; and (3) H_{03}: There is no significant relationship between the perceived usefulness, ease of use, attitude toward use, and behavioral intention to use AI-powered referencing tools and the actual use of these tools among Filipino science educators.*

4. METHOD

Research Design

The study utilized a quantitative, cross-sectional descriptive design to assess the technology acceptance of AI-powered referencing tools among Filipino science educators.

Respondents and Sampling Procedure

The population comprises science educators from two universities. To ensure a representative sample, a stratified random sampling randomly selected from DepEd Schools and Universities. This approach allows for a more balanced representation of both institutions, resulting in a sample size of 71 educators. The 71 science teachers were based on the 95% confidence level with a 10% margin of error with 189 population of respondents. Stratified random sampling ensures that the sample reflects the diversity within the population, enhancing the validity and reliability of the study's findings. Table 1 presents the Profile Characteristics of the Respondents.

Table 1. Profile Characteristics of the Respondents

Variables	Categories	Frequency (N=71)	Percentage
Sex	Male	30	42
	Female	41	58
Age	20-27	20	28
	28-35	22	31
	36-42	27	38
	43-49	2	3
	50 and above	0	0
Years of Service	5 years and below	5	7
	6-10 years	19	27
	11-15 years	30	42
	16-20 years	13	18
	21 and above	4	6

The profile of the respondents reveals a diverse demographic, with a slight majority being female (58%), and most participants falling within the age range of 36-42 years (38%). Additionally, the majority of respondents have 11-15 years of service (42%), indicating a well-experienced group within the sample.

Research Instrumentation

The study employed the use of survey research tool with a scale of 5 as the highest and 1 as the lowest. It consisted of 15 items. The tool was mainly adopted from the original tool of Davis (1989) on the Technology Acceptance Model Questionnaire. The research utilized validated measurement instruments to assess various aspects of AI-

powered referencing tools among Filipino science educators. Based on its local validation and reliability testing, the tool has a reliability coefficient of 0.8005 (sd=0.85) which can be interpreted as "good reliability." Table 2 presents the reliability coefficient of the variables.

Table 2. Reliability coefficient of the variables.

Variables	Number of Items	Number of Items Removed	Cronbach's Alpha	Interpretation
Perceived Usefulness (PU)	3	0	.853	Good reliability
Perceived Ease of Use (PEOU)	3	0	.844	Good reliability
Attitude Toward Use (ATU)	3	0	.813	Good reliability
Behavioral Intention to Use (BIU)	3	0	.807	Good reliability
Actual Use (AU)	3	0	.905	Excellent Reliability
General Items	15	0	.861	Good Reliability

The reliability analysis of the variables indicates that all constructs, including Perceived Usefulness, Perceived Ease of Use, Attitude Toward Use, Behavioral Intention to Use, and Actual Use, demonstrate good to excellent reliability, with Cronbach's Alpha values ranging from .807 to .905, ensuring the consistency and dependability of the measurement items used in the study. The tool was pilot tested to pre-service science teachers with the total of 70 respondents. SPSS was used to test the scale reliability of the instruments.

Data Gathering Procedure

A systematic survey was used to gather data for the study, and it was sent to the 71 scientific instructors who were chosen. To provide accessibility and convenience for all respondents, the survey was distributed both in-person and online. Participants were made aware of the study's objectives, the voluntary nature of their participation, and the confidentiality of their answers prior to the survey. Participants were given the choice to withdraw at any moment without facing any repercussions, and informed consent was acquired. The study team was the only ones with access to the securely kept data, and the survey responses were anonymised to safeguard the respondents' identity. The Institutional Review Board (IRB) at each of the participating universities granted ethical approval for the study, guaranteeing high level of ethical consideration. Likewise, data privacy consent was also secured by the respondents.

Data Analysis and Statistical Analysis

In this study, data were analyzed using descriptive and inferential statistics. For descriptive, the level of technology adoption was analyzed using this range and interpretation *in Table 3 description and interpretation.*

Table 3 description and interpretation for Descriptive statistics

Scale	Description	Interpretation	Range
5	Strongly Disagree	Extremely positive, highly favorable	1.00 - 1.79
4	Disagree	Positive, favorable	1.80 - 2.59
3	Neutral	Neither positive nor negative	2.60 - 3.39
2	Agree	Negative, unfavorable	3.40 - 4.19
1	Strongly Agree	Highly negative, extremely unfavorable	4.20 - 5.00

For descriptive statistics, data were presented using frequency, percentage mean, standard deviation. To assure proper statistical l tool and analysis, data gathered were subjected to normality testing using Kolmogorov-Smirnov and Shapiro Wilk Tests. For the inferential part, data were presented using Mann-Whitney U Test and Kruskal Wallis Test. Further, Kendall's Tau was used to test the relationship of variables.

Table 4 presents the test of normality of the data. Results showed that all the data were not normally distributed across the four dimensions of AI acceptability. This suggest the use of non-parametric tools to ascertain the hypotheses of the study.

Table 4. Test of Normality of Data

	Kolmogorov-Smirnov[a]			Shapiro-Wilk			Interpretation
	Statistic	df	Sig.	Statistic	df	Sig.	Not Normal
Perceived Usefulness (PU)	.238	71	.000	.844	71	.000	Not Normal

Perceived Ease of Use (PEOU)	.254	71	.000	.864	71	.000	Not Normal
Attitude Toward Use (ATU)	.186	71	.000	.866	71	.000	Not Normal
Behavioral Intention to Use (BIU)	.174	71	.000	.909	71	.000	Not Normal
Actual Use (AU)	.124	71	.008	.942	71	.003	Not Normal
Technology Acceptance of AI Powered Tools as referencing tools	.156	71	.000	.949	71	.006	Not Normal
a. Lilliefors Significance Correction							

5. RESULT AND DISCUSSION

Frequency of Using the Selected AI Referencing Tools and Search Engines

Figure 1 presents percentage of Utility of the Selected AI Referencing Tools and Search Engines. As shown in the data, it is well noted that preferences among respondents for various AI referencing and search engine tools, the Google Scholar and Semantic Scholar are the most popular, with all respondents (100%) using Google Scholar and 97.2% using Semantic Scholar. This widespread use reflects their effectiveness as powerful search engines. When it comes to referencing tools, RefWorks is the most commonly used, with 91.5% of respondents relying on it, demonstrating its importance in reference management. EndNote and *Cite This For Me* are also frequently used by 67.6% of respondents each, showing their significant role in managing citations. Mendeley is used by 63.4% of respondents, further emphasizing its value in the referencing process. *Zotero* is the least popular among the referencing tools, with only 42.3% usage, suggesting that it might need improvements or may not be as well regarded as other tools.

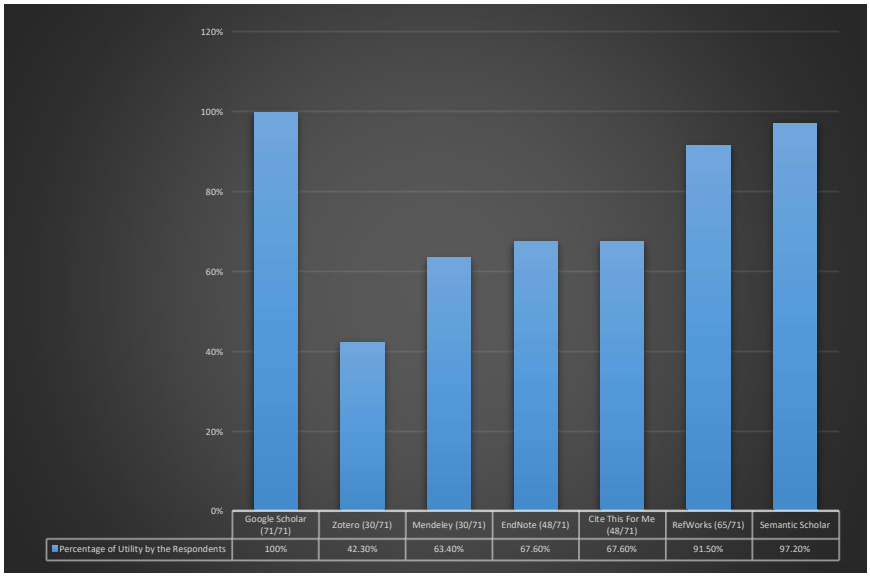

Figure 1. Percentage of Utility of the Selected AI Referencing Tools and Search Engines

Based on these results , it reflect a strong preference for tools that aid in effective information retrieval and reference management, with varying levels of adoption highlighting areas where some tools may benefit from increased promotion or enhancements to better meet user needs.

Assessment on the Perceived Usefulness, Ease of Use, Attitude, and Behavioral Intention to Use AI-Powered Referencing Tools and Search Engines

The results of the study on the perceived usefulness, ease of use, attitude, and behavioral intention to use AI-powered referencing tools among Filipino science educators are presented in Table 2. The data reveal a high level of acceptance and positive perception of these tools. The findings indicate that Filipino science educators perceive AI-powered referencing tools as highly useful and beneficial for their academic work, reflecting a strong positive attitude and a high intention to use these tools. However, the mixed responses regarding the ease of use highlight a need for improvements in user experience and integration processes.

Table 5. *Perceived Usefulness, Ease of Use, Attitude, and Behavioral Intention to Use AI-Powered Referencing Tools*

Subdomain	Items	Mean (N=71)	SD	Interpretation
Perceived Usefulness (PU)	1. I believe that AI-powered referencing tools improve the quality of my academic references.	4.86	0.39	Strongly Agree
	2. Using AI-powered referencing tools saves me time when creating bibliographies for my research.	4.48	0.58	Strongly Agree
	3. AI-powered referencing tools enhance the accuracy of citation formatting in my academic papers.	4.23	0.68	Strongly Agree
Perceived Ease of Use (PEOU)	4. I find AI-powered referencing tools easy to use for generating citations.	3.06	0.23	Neutral
	5. Learning to use AI-powered referencing tools is straightforward for me.	3.83	0.84	Agree
	6. I find it easy to integrate AI-powered referencing tools into my existing research workflow.	4.56	0.50	Strongly Agree
Attitude Toward Use (ATU)	7. I have a positive attitude toward using AI-powered referencing tools in my research.	4.35	0.68	Strongly Agree
	8. I enjoy using AI-powered referencing tools for my academic work.	4.15	0.80	Agree
Behavioral Intention to Use (BIU)	9. I believe that using AI-powered referencing tools is beneficial for my professional development.	4.46	0.50	Strongly Agree
	10. I intend to use AI-powered referencing tools regularly in my research activities.	4.46	0.50	Strongly Agree
	11. I plan to recommend AI-powered referencing tools to my colleagues and students.	4.37	0.74	Strongly Agree
	12. I am likely to explore other AI-powered tools in my research after using AI-powered referencing tools.	3.99	0.64	Agree
Actual Use (AU)	13. I frequently use AI-powered referencing tools in my academic work.	3.51	0.84	Agree
	14. I have integrated AI-powered referencing tools into my regular research routine.	3.97	1.23	Agree
	15. I rely on AI-powered referencing tools for most of my citation needs in academic papers.	3.87	1.15	Agree

Perusing the table on Perceived Usefulness (PU), the educators strongly agreed that AI-powered referencing tools improve the quality of academic references (M = 4.86, SD = 0.39), save time when creating bibliographies (M = 4.48, SD = 0.58), and enhance the accuracy of citation formatting (M = 4.23, SD = 0.68). This suggests that the participants view these tools as highly beneficial for improving the quality and efficiency of their academic work.

In like manner, the assessment on the Perceived Ease of Use (PEOU), participants' views on ease of use were mixed. While they agreed that integrating these tools into their research workflow is easy (M = 4.56, SD = 0.50), their perception of the tools' overall ease of use for generating citations was neutral (M = 3.06, SD = 0.23). This discrepancy highlights a potential area for improvement in the user experience of these tools.

Looking at the Attitude Toward Use (ATU), the educators had a strong positive attitude towards using AI-powered referencing tools, as evidenced by their strong agreement with statements about having a positive attitude (M =

4.35, SD = 0.68) and enjoying their use (M = 4.15, SD = 0.80). This indicates that the participants are generally enthusiastic about incorporating these tools into their academic practices.

As to Behavioral Intention to Use (BIU), the participants strongly agreed that AI-powered referencing tools are beneficial for their professional development (M = 4.46, SD = 0.50), and they intended to use these tools regularly (M = 4.46, SD = 0.50) and recommend them to others (M = 4.37, SD = 0.74). This high level of agreement suggests a strong inclination towards continued use and promotion of these tools.

Further, the Actual Use (AU), although participants reported an agreement on frequently using (M = 3.51, SD = 0.84) and integrating (M = 3.97, SD = 1.23) AI-powered referencing tools into their routines, their reliance on these tools for most citation needs was only slightly agreed upon (M = 3.87, SD = 1.15). This indicates that while these tools are used regularly, there may still be instances where alternative methods are employed.

The results show that Filipino scientific instructors have a strong favorable attitude and a high intention to utilize AI-powered reference tools, which they view as extremely advantageous and valuable for their academic work. The contradictory feedback on the usability, however, emphasizes the necessity of enhancing the user experience and integration procedures. Given their high perceived utility and strong desire to use and recommend them, it is possible that these tools may become an essential component of these educators' academic workflows with a few tweaks. The findings also imply that, despite widespread use, there may be a need to depend more on these technologies to get the most out of them.

Mann-Whitney U Test of Difference on the Technology Acceptance of AI Powered Tools as referencing tools when grouped according to Sex

Table 6 presents the Mann-Whitney U test was employed to examine differences in technology acceptance of AI-powered referencing tools between male and female users. The analysis revealed significant differences in Perceived Usefulness (PU), Perceived Ease of Use (PEOU), and Behavioral Intention to Use (BIU), but not in Attitude Toward Use (ATU) or Actual Use (AU).

Table 6. *Mann-Whitney U Test of Difference on the Technology Acceptance of AI Powered Tools as referencing tools when grouped according to Sex*

	Mean	Std. Deviation	Mann-Whitney U	P Value	Interpretation
Perceived Usefulness (PU)	4.52	.35	391.500	.006	significant
Perceived Ease of Use (PEOU)	3.80	.39	321.500	.000	Significant
Attitude Toward Use (ATU)	4.32	.58	523.500	.275	Not significant
Behavioral Intention to Use (BIU)	4.27	.54	421.500	.022	Significant
Actual Use (AU)	3.78	.62	500.500	.176	Not significant

The results highlight significant differences in how male and female users perceive the usefulness and ease of use of AI-powered referencing tools, as well as their behavioral intention to use these tools. These findings suggest that while both sexes value the tools and intend to use them, their perceptions of usefulness and ease of use vary. The absence of significant differences in attitudes and actual use indicates that once users engage with the tools, their overall experiences and usage patterns are similar regardless of sex. These insights underscore the importance of considering gender differences in the development and promotion of AI-powered referencing tools to enhance user satisfaction and adoption.

The analysis of technology acceptance of AI-powered referencing tools reveals significant gender differences in several key areas. For Perceived Usefulness (PU), the mean score was 4.52 (SD = 0.35), with a Mann-Whitney U value of 391.500 and a p-value of 0.006, indicating a significant difference between male and female users. This finding suggests notable variations in how different sexes perceive the usefulness of these tools. Similarly, Perceived Ease of Use (PEOU) had a mean score of 3.80 (SD = 0.39), with a Mann-Whitney U value of 321.500 and a p-value of 0.000, reflecting a significant difference in perceptions of ease of use between genders.

In contrast, Attitude Toward Use (ATU) showed a mean score of 4.32 (SD = 0.58), with a Mann-Whitney U value of 523.500 and a p-value of 0.275, indicating no significant difference in attitudes toward using AI-powered referencing tools between sexes. Similarly, Actual Use (AU) had a mean score of 3.78 (SD = 0.62), with a Mann-Whitney U value of 500.500 and a p-value of 0.176, suggesting that the actual usage of these tools does not significantly differ between male and female users.

However, the Behavioral Intention to Use (BIU) was found to have a mean score of 4.27 (SD = 0.54), with a Mann-Whitney U value of 421.500 and a p-value of 0.022, showing a significant difference in the intention to use AI-powered referencing tools across sexes. This indicates that while attitudes and actual usage are similar, the intention to adopt and use these tools varies significantly between male and female users.

Kruskal Wallis Test of Difference on the Technology Acceptance of AI Powered Tools as referencing tools when grouped according to Age

Table 7 shows the the Kruskal-Wallis test was conducted to explore differences in the acceptance of AI-powered referencing tools among users of different age groups. The test results indicated no significant differences across age groups in any of the measured dimensions. The Kruskal-Wallis test results demonstrate that there are no significant differences in technology acceptance of AI-powered referencing tools based on age. Across all measured dimensions—perceived usefulness, ease of use, attitude, behavioral intention, and actual use—users of different ages exhibit similar perceptions and behaviors. These findings imply that age does not significantly influence the acceptance and usage of AI-powered referencing tools, suggesting that these tools are equally valued and utilized across various age groups.

Table 7. *Kruskal Wallis Test of Difference on the Technology Acceptance of AI Powered Tools as referencing tools when grouped according to Age*

	Mean	Std. Deviation	Kruskal-Wallis H	P value	Interpretation
Perceived Usefulness (PU)	4.52	.350	2.258	.521	Not significant
Perceived Ease of Use (PEOU)	3.81	.39	.749	.862	Not significant
Attitude Toward Use (ATU)	4.32	.58	.452	.929	Not significant
Behavioral Intention to Use (BIU)	4.27	.54	3.062	.382	Not significant
Actual Use (AU)	3.78	.62	4.052	.256	Not significant
Technology Acceptance of AI Powered Tools as referencing tools	4.14	.374	1.148	.766	Not significant

The results revealed that perceptions of the usefulness of these tools were consistent across ages, with a mean score of 4.52 (SD = 0.350) and a Kruskal-Wallis H value of 2.258 (p = 0.521). Similarly, the perceived ease of use was uniformly recognized across age groups, as indicated by a mean score of 3.81 (SD = 0.39) and a Kruskal-Wallis H value of 0.749 (p = 0.862). Attitudes toward using the tools also showed no significant variation, with a mean score of 4.32 (SD = 0.58) and a Kruskal-Wallis H value of 0.452 (p = 0.929). The behavioral intention to use the tools was similar among age groups, reflected in a mean score of 4.27 (SD = 0.54) and a Kruskal-Wallis H value of 3.062 (p = 0.382). Finally, the actual use of AI-powered referencing tools did not differ significantly by age, as evidenced by a mean score of 3.78 (SD = 0.62) and a Kruskal-Wallis H value of 4.052 (p = 0.256).

Kendall's tau Test of Relationship Between Perceived Usefulness, Ease of Use, Attitude, and Actual Use of AI-Powered Referencing Tools Among Filipino Science Educators

The Kendall's tau test was conducted to explore the relationships between perceived usefulness, perceived ease of use, attitude toward use, behavioral intention to use, and actual use of AI-powered referencing tools among Filipino science educators. The results indicated several significant correlations. While perceived usefulness and actual use did not exhibit a significant correlation, other relationships between perceived ease of use, attitude, intention, and actual use were statistically significant. This suggests that factors such as ease of use, positive attitudes, and strong intentions play a more crucial role in determining the actual use of AI-powered referencing tools among Filipino science educators.

Perceived usefulness (PU) was positively correlated with perceived ease of use (PEOU) ($\tau = 0.311$, $p = 0.002$), attitude toward use (ATU) ($\tau = 0.466$, $p < 0.001$), and behavioral intention to use (BIU) ($\tau = 0.530$, $p < 0.001$), suggesting that higher perceived usefulness is associated with more favorable perceptions and intentions regarding AI-powered tools. However, the correlation between perceived usefulness and actual use (AU) was not significant ($\tau = 0.177$, $p = 0.071$).

Perceived ease of use (PEOU) showed positive correlations with attitude toward use (ATU) ($\tau = 0.395$, $p < 0.001$), behavioral intention to use (BIU) ($\tau = 0.541$, $p < 0.001$), and actual use (AU) ($\tau = 0.232$, $p = 0.016$), indicating that easier use of the tools is related to more positive attitudes, higher intentions to use, and increased actual usage.

Attitude toward use (ATU) had a strong positive correlation with behavioral intention to use (BIU) ($\tau = 0.661$, p

< 0.001) and a modest positive correlation with actual use (AU) (τ = 0.211, p = 0.025), showing that a positive attitude is strongly related to both the intention to use and the actual usage of the tools. Similarly, behavioral intention to use (BIU) was positively correlated with actual use (AU) (τ = 0.184, p = 0.049), suggesting that a higher intention to use is associated with more frequent actual use.

Table 8. Kendall's tau Test of Relationship between Perceived Usefulness, Ease of Use, Attitude, and Actual Use of AI-Powered Referencing Tools among Filipino Science Educators

			Perceived Usefulness (PU)	Perceived Ease of Use (PEOU)	Attitude Toward Use (ATU)	Behavioral Intention to Use (BIU)	Actual Use (AU)
Kendall's tau_b	Perceived Usefulness (PU)	Correlation Coefficient	1.000	.311**	.466**	.530**	.177
		Sig. (2-tailed)	.	.002	.000	.000	.071
		N	71	71	71	71	71
	Perceived Ease of Use (PEOU)	Correlation Coefficient	.311**	1.000	.395**	.541**	.232*
		Sig. (2-tailed)	.002	.	.000	.000	.016
		N	71	71	71	71	71
	Attitude Toward Use (ATU)	Correlation Coefficient	.466**	.395**	1.000	.661**	.211*
		Sig. (2-tailed)	.000	.000	.	.000	.025
		N	71	71	71	71	71
	Behavioral Intention to Use (BIU)	Correlation Coefficient	.530**	.541**	.661**	1.000	.184*
		Sig. (2-tailed)	.000	.000	.000	.	.049
		N	71	71	71	71	71
	Actual Use (AU)	Correlation Coefficient	.177	.232*	.211*	.184*	1.000
		Sig. (2-tailed)	.071	.016	.025	.049	.
		N	71	71	71	71	71
***. Correlation is significant at the 0.01 level (2-tailed).*							
**. Correlation is significant at the 0.05 level (2-tailed).*							

DISCUSSION

The analysis of technology acceptance of AI-powered referencing tools among science educators reveals several key insights into their perceptions and usage patterns. The results demonstrate a strong overall positive perception of these tools, particularly in terms of their perceived usefulness and the positive attitudes educators have towards them. Educators view these tools as highly beneficial for improving the quality of academic references and saving time when creating bibliographies. This aligns with previous research indicating that perceived usefulness is a significant predictor of technology adoption (Davis, 1989).

However, the mixed responses regarding the ease of use highlight an area that requires attention. While educators find it easy to integrate these tools into their existing workflows, they report a neutral stance on the overall ease of use for generating citations. This discrepancy suggests that while integration is manageable, the user experience could be improved to make the tools more intuitive and user-friendly. This finding echoes the concerns raised in other studies, which emphasize the importance of user-centered design in technology adoption (Fleury & Chaniaud, 2024).

In like manner, the study also examined gender differences in technology acceptance. Significant differences were found in perceived usefulness, ease of use, and behavioral intention to use AI-powered referencing tools between male and female users. These differences suggest that while both genders find the tools valuable and intend to use them, their perceptions of usefulness and ease of use vary. This result is consistent with prior research that has identified gender differences in technology acceptance, where men and women may have different expectations and experiences with technology (Sánchez-Prieto, et a, 2020, Ruiz, Herrera, et al, 2023, Mogali et al, 2024).

In contrast, no significant differences were observed in attitudes toward use and actual use across genders, indicating that once engaged with the tools, both sexes have similar experiences and usage patterns. This finding suggests that while initial perceptions may differ, the ultimate satisfaction and application of the tools converge. This is in line with studies that found attitudes and usage patterns can align despite differences in initial perceptions (Tavera-Mesias & Collazos, 2023, Ilyas et al 2023).

When exploring technology acceptance across different age groups, the Kruskal-Wallis test indicated no significant differences. This result implies that age does not influence the acceptance and usage of AI-powered referencing tools, suggesting that these tools are uniformly valued across various age demographics. This aligns with the literature that suggests technology acceptance can be consistent across age groups, particularly when the technology offers clear benefits (Fasbender, Gerpott & Rinker, 2023, Mannheim et al, 2023).

Lastly, the Kendall's tau test revealed significant correlations between perceived ease of use, attitude toward use, behavioral intention to use, and actual use. Specifically, perceived ease of use was positively correlated with attitude, intention, and actual use, reinforcing the notion that ease of use is crucial for technology adoption (Davis, 1989). Additionally, a positive attitude was strongly related to both the intention to use and actual usage of the tools. This finding supports the Technology Acceptance Model (TAM), which posits that perceived ease of use and perceived usefulness significantly impact attitudes and behavioral intentions (Chocarro et al, 2023, Sulistiani et al 2023).

This study highlights that while science educators have a positive perception of AI-powered referencing tools, there are areas for improvement in usability. Gender differences in perceptions of usefulness and ease of use should be considered in the design and promotion of these tools. The uniform acceptance across age groups suggests broad applicability, while the strong correlations between ease of use, attitude, and actual use underscore the importance of these factors in technology adoption. Future developments should focus on enhancing user experience to address the concerns identified and capitalize on the positive attitudes and high intentions to use these tools.

6. CONCLUSION

This study employed quantitative, cross-sectional descriptive design to assess the technology acceptance of AI-powered referencing tools among selected 71 science teachers as respondents. Results revealed the study reveals that Filipino science educators generally have a positive perception of AI-powered referencing tools, particularly regarding their usefulness and the benefits they offer in enhancing academic referencing. However, there are usability challenges that need to be addressed, as mixed responses regarding ease of use indicate room for improvement in user experience. Gender differences in perceptions of usefulness and ease of use were noted, but both male and female educators ultimately shared similar attitudes and usage patterns once engaged with the tools. The uniform acceptance across age groups further suggests that these tools are widely valued, with strong correlations between ease of use, attitude, and actual usage reinforcing the critical role of user-friendly design in technology adoption.

RECOMMENDATIONS

Based on the findings, it is recommended that developers of AI-powered referencing tools focus on improving the user experience to address the usability challenges identified by educators. Enhancing the intuitiveness and ease of use of these tools will likely increase adoption and satisfaction among users. Additionally, targeted efforts should be made to address the varying perceptions of usefulness and ease of use between male and female educators, possibly through tailored training or user support. Lastly, continued emphasis on user-centered design will be crucial in ensuring that these tools meet the needs of a diverse user base, regardless of age or gender.

The study's limitations include its reliance on a relatively small sample size, which may not fully represent the broader population of Filipino science educators, and its cross-sectional design, which captures perceptions at a single point in time, potentially overlooking evolving attitudes. Future research should explore longitudinal studies to track changes in technology acceptance over time and expand the sample to include educators from diverse regions and disciplines. Additionally, qualitative research could provide deeper insights into the specific usability challenges faced by educators. Ethical implications of using AI-powered referencing tools include the need to ensure data privacy and security, as these tools often require access to personal and academic information. There is also a potential risk of over-reliance on AI, which could diminish critical thinking and research skills if not used responsibly. Ensuring transparency in how these tools function and promoting ethical usage practices among educators will be essential in mitigating these concerns.

REFERENCES

Al Darayseh, A. (2023). Acceptance of artificial intelligence in teaching science: Science teachers' perspective. Computers and Education: Artificial Intelligence, 4, 100132.

Al-Abdullatif, A. M. (2023). Modeling Students' perceptions of chatbots in learning: Integrating technology

acceptance with the value-based adoption model. Education Sciences, 13(11), 1151.

Al-Adwan, A. S., Li, N., Al-Adwan, A., Abbasi, G. A., Albelbisi, N. A., & Habibi, A. (2023). Extending the technology acceptance model (TAM) to Predict University Students' intentions to use metaverse-based learning platforms. Education and Information Technologies, 28(11), 15381-15413.

Alharbi, W. (2023). AI in the foreign language classroom: A pedagogical overview of automated writing assistance tools. Education Research International, 2023(1), 4253331.

Almasri, F. (2024). Exploring the impact of artificial intelligence in teaching and learning of science: A systematic review of empirical research. Research in Science Education, 1-21.

Arguson, A., Mabborang, M., & Paculanan, R. (2023). The acceptability of generative ai tools of selected senior high school teachers in schools divisions office-manila, philippines. Journal of Artificial Intelligence, Machine Learning and Neural Network, 3(6), 1-10.

Balakrishnan, J., Dwivedi, Y. K., Hughes, L., & Boy, F. (2024). Enablers and inhibitors of AI-powered voice assistants: a dual-factor approach by integrating the status quo bias and technology acceptance model. Information Systems Frontiers, 1-22.

Bantoto, F. M. O., Rillo, R., Abequibel, B., Mangila, B. B., & Alieto, E. O. (2024, February). Is AI an Effective "Learning Tool" in Academic Writing? Investigating the Perceptions of Third-Year University Students on the Use of Artificial Intelligence in Classroom Instruction. In International Conference on Digital Technologies and Applications (pp. 72-81). Cham: Springer Nature Switzerland.

Cardon, P., Fleischmann, C., Aritz, J., Logemann, M., & Heidewald, J. (2023). The challenges and opportunities of AI-assisted writing: Developing AI literacy for the AI age. Business and Professional Communication Quarterly, 86(3), 257-295.

Choi, S., Jang, Y., & Kim, H. (2023). Influence of pedagogical beliefs and perceived trust on teachers' acceptance of educational artificial intelligence tools. International Journal of Human–Computer Interaction, 39(4), 910-922.

Choung, H., David, P., & Ross, A. (2023). Trust in AI and its role in the acceptance of AI technologies. International Journal of Human–Computer Interaction, 39(9), 1727-1739.

Chounta, I. A., Bardone, E., Raudsep, A., & Pedaste, M. (2022). Exploring teachers' perceptions of artificial intelligence as a tool to support their practice in Estonian K-12 education. International Journal of Artificial Intelligence in Education, 32(3), 725-755.

Cooper, G. (2023). Examining science education in ChatGPT: An exploratory study of generative artificial intelligence. Journal of Science Education and Technology, 32(3), 444-452.

Cooper, G. (2023). Examining science education in ChatGPT: An exploratory study of generative artificial intelligence. Journal of Science Education and Technology, 32(3), 444-452.

Du, Y., & Gao, H. (2022). Determinants affecting teachers' adoption of AI-based applications in EFL context: An analysis of analytic hierarchy process. Education and Information Technologies, 27(7), 9357-9384.

Espartinez, A. S. (2024). Exploring student and teacher perceptions of ChatGPT use in higher education: A Q-Methodology study. Computers and Education: Artificial Intelligence, 7, 100264.

Fleury, S., & Chaniaud, N. (2024). Multi-user centered design: acceptance, user experience, user research and user testing. Theoretical Issues in Ergonomics Science, 25(2), 209-224.

Galindo-Domínguez, H., Delgado, N., Losada, D., & Etxabe, J. M. (2024). An analysis of the use of artificial intelligence in education in Spain: The in-service teacher's perspective. Journal of Digital Learning in Teacher Education, 40(1), 41-56.

Garcia, M. B. (2024). Factors affecting adoption intention of productivity software applications among teachers: A structural equation modeling investigation. International Journal of Human–Computer Interaction, 40(10), 2546-2559.

Hueber, A. J., & Kleyer, A. (2023). Quality of citation data using the natural language processing tool ChatGPT in rheumatology: creation of false references. RMD open, 9(2), e003248.

Ilyas, M., ud din, A., Haleem, M., & Ahmad, I. (2023). Digital entrepreneurial acceptance: an examination of technology acceptance model and do-it-yourself behavior. Journal of Innovation and Entrepreneurship, 12(1), 15.

Ilyas, M., ud din, A., Haleem, M., & Ahmad, I. (2023). Digital entrepreneurial acceptance: an examination of technology acceptance model and do-it-yourself behavior. Journal of Innovation and Entrepreneurship, 12(1), 15.

Junio, D. A., & Bandala, A. A. (2023, November). Utilization of Artificial Intelligence in Academic Writing Class: L2 Learners Perspective. In 2023 IEEE 15th International Conference on Humanoid, Nanotechnology, Information Technology, Communication and Control, Environment, and Management (HNICEM) (pp. 1-6). IEEE.

Kim, N. J., & Kim, M. K. (2022, March). Teacher's perceptions of using an artificial intelligence-based educational tool for scientific writing. In Frontiers in Education (Vol. 7, p. 755914). Frontiers Media SA.

Kim, N. J., & Kim, M. K. (2022, March). Teacher's perceptions of using an artificial intelligence-based educational tool for scientific writing. In Frontiers in Education (Vol. 7, p. 755914). Frontiers Media SA. Alharbi, W. (2023). AI in the foreign language classroom: A pedagogical overview of automated writing assistance tools. Education Research International, 2023(1), 4253331.

Leung, T. I., de Azevedo Cardoso, T., Mavragani, A., & Eysenbach, G. (2023). Best practices for using AI tools as an author, peer reviewer, or editor. Journal of Medical Internet Research, 25, e51584.

Lin, C. Y., & Xu, N. (2022). Extended TAM model to explore the factors that affect intention to use AI robotic architects for architectural design. Technology Analysis & Strategic Management, 34(3), 349-362.

Liu, G., & Ma, C. (2024). Measuring EFL learners' use of ChatGPT in informal digital learning of English based on the technology acceptance model. Innovation in Language Learning and Teaching, 18(2), 125-138.

Llaneza, P. D. R., & Magulod Jr, G. C. (2023). "Abot Kamay and Pagsasanay": Effectiveness of Tactual Learning Kit as a Localized Manipulative Instructional Material in Grade 1 Mathematics. Journal of Social Sciences and Humanities, 1(1), 13-13.

Mannheim, I., Varlamova, M., van Zaalen, Y., & Wouters, E. J. (2023). The role of ageism in the acceptance and use of digital technology. Journal of Applied Gerontology, 42(6), 1283-1294.

Mogaji, E., Viglia, G., Srivastava, P., & Dwivedi, Y. K. (2024). Is it the end of the technology acceptance model in the era of generative artificial intelligence?. International Journal of Contemporary Hospitality Management.

Na, S., Heo, S., Han, S., Shin, Y., & Roh, Y. (2022). Acceptance model of artificial intelligence (AI)-based technologies in construction firms: Applying the Technology Acceptance Model (TAM) in combination with the Technology–Organisation–Environment (TOE) framework. Buildings, 12(2), 90.

Nazaretsky, T., Ariely, M., Cukurova, M., & Alexandron, G. (2022). Teachers' trust in AI-powered educational technology and a professional development program to improve it. British journal of educational technology, 53(4), 914-931.

Owan, V. J., Abang, K. B., Idika, D. O., Etta, E. O., & Bassey, B. A. (2023). Exploring the potential of artificial intelligence tools in educational measurement and assessment. Eurasia Journal of Mathematics, Science and Technology Education, 19(8), em2307.

Rad, D., Magulod Jr, G. C., Balas, E., Roman, A., Egerau, A., Maier, R., ... & Chis, R. (2022). A radial basis function neural network approach to predict preschool teachers' technology acceptance behavior. Frontiers in Psychology, 13, 880753.

Ruiz-Herrera, L. G., Valencia-Arias, A., Gallegos, A., Benjumea-Arias, M., & Flores-Siapo, E. (2023). Technology acceptance factors of e-commerce among young people: An integration of the technology acceptance model and theory of planned behavior. Heliyon, 9(6).

Sánchez-Prieto, J. C., Cruz-Benito, J., Therón Sánchez, R., & García-Peñalvo, F. J. (2020). Assessed by machines: Development of a TAM-based tool to measure AI-based assessment acceptance among students. International Journal of Interactive Multimedia and Artificial Intelligence, 6(4), 80.

Santiago Jr, C. S., Embang, S. I., Conlu, M. T. N., Acanto, R. B., Lausa, S. M., Ambojia, K. W. P., ... & Romasanta, J. K. N. (2023). Utilization of writing assistance tools in research in selected higher learning institutions in the philippines: A text mining analysis. International Journal of Learning, Teaching and Educational Research, 22(11), 259-284.

Sharma, B. K., Kumar, V. R., & Bhatt, V. K. (2024). Factors influencing E-learning technology among youth in India: an extended TAM model. Management and Labour Studies, 49(3), 504-526.

Sulistiani, I. R., Setyosari, P., Sa'dijah, C., & Praherdhiono, H. (2023). Technology integration through acceptance of e-learning among preservice teachers. Indonesian Journal of Electrical Engineering and Computer Science, 31(3), 1821-1828.

Sachdeva, G., Ganjoo, M. & Borah, T. (2024). The Impact of Digital Media Consumption on the Academic Performance of Children in the Global South: A Bibliometric Analysis Using Scopus Database. Library Progress International, 44(2), 6-18. https://bpasjournals.com/library-science/index.php/journal/article/view/235

Tavera-Mesías, J. F., Van Klyton, A., & Collazos, A. Z. (2023). Technology readiness, mobile payments and gender-a reflective-formative second order approach. Behaviour & Information Technology, 42(7), 1005-1023.

Talreja, B., & Agashe, A. (2024). Digital Library Transformation's Role in Enhancing Student Relationship Management Systems in Nagpur's Educational Institutions. Library Progress International, 44(2), 1-5. https://bpasjournals.com/library-science/index.php/journal/article/view/234

Villarino, R. T. H., & Villarino, M. L. (2024). Advancing instrument validation in social sciences: An AI-powered chatbot and interactive website based on a Research Instrument Validation Framework (RIVF). SSRN Electronic Journal. https://doi. org/10.2139/ssrn, 4910804.

Wang, B., Rau, P. L. P., & Yuan, T. (2023). Measuring user competence in using artificial intelligence: validity and reliability of artificial intelligence literacy scale. Behaviour & information technology, 42(9), 1324-1337.

Yeo, M. A. (2023). Academic integrity in the age of Artificial Intelligence (AI) authoring apps. Tesol Journal, 14(3), e716.

Zhang, C., Schießl, J., Plößl, L., Hofmann, F., & Gläser-Zikuda, M. (2023). Acceptance of artificial intelligence among pre-service teachers: a multigroup analysis. International Journal of Educational Technology in Higher Education, 20(1), 49.