Research Trends in the Use of Automated Writing Evaluation Tools

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Abstract

This systematic review aimed to present a systematic summary of the trends and use of Automated Writing Evaluation (AWE) tools, particularly in teaching writing skills in the university context. Research articles were collected from three different databases, namely Eric, Taylor & Francis, and Scopus. After being reviewed based on selected inclusion and exclusion criteria, 21 studies out of 76 collected articles were then further examined. The findings of this study showed that the use of AWE tools increased from 2020 to 2022. In addition, the majority of studies were conducted in China where English is learned as a second or foreign language. Then, most of the reviewed studies were developed based on the quantitative research design. Meanwhile, regarding the AWE tools, Pigai was found to be dominantly used by students, and the second most commonly used tools were Grammarly and Criterion. At last, based on this systematic review, AWE tools were frequently used to help students to write essays.

Keywords: *Automated writing evaluation, written corrective feedback, writing skills*

1. Introduction

To excel in academic writing, students should be able to show proper language and grammatical standards. However, with no sufficient instruction, they will not be able to develop their writing ability and show the aforementioned standards of language and grammar. Students need outside assistance which includes receiving precise grammar, punctuation, and spelling feedback (O'neill & Russell, 2019). However, in conventional English writing classes, lecturers often face large class sizes, thus making it difficult to provide timely feedback for each student, although providing feedback to students is a common practice for improving students' writing skills and sense of audience and understanding (Y. Wang et al., 2022; Zhang & Hyland, 2018). Studies have shown that personalized feedback not only enhances writing skills but also increases student motivation and engagement (Hamidun et al., 2013; H. Thi & Nguyen, 2021; Valiantien et al., n.d.; H. Wang & Lehman, 2021). Additionally, research indicates that consistent, targeted feedback helps students internalize grammatical rules and improve their overall writing proficiency (Hyland, 2013). Furthermore, the integration of technology in providing automated feedback can alleviate some of the burdens on instructors and offer immediate assistance to students.

In response to the stated issue, Automated Writing Evaluation (AWE) is used to complement teacher feedback in writing. Due to their many benefits, the use

of AWE tools and comparable tools for assessment in ESL and EFL writing classes has rapidly grown. AWE tools offer a wide range of feedback that supports and enhances the written corrective feedback provided by lecturers. The input provided by AWE tools covers various aspects of writing, including word choice, verb tense, verb form, word form, articles (the misuse of zero, definite, and indefinite articles), noun ending errors (singular and plural nouns), pronouns, run-on sentences (comma splices), fragments (incomplete clauses), punctuation, misspelled words, missing and unnecessary words and phrases, subject-verb agreement, and inappropriate choice of prepositions (Han & Hyland, 2015)

Recent studies have highlighted the growing acceptance and effectiveness of AWE tools in educational settings. For instance, research has demonstrated that AWE can significantly improve students' writing performance by providing immediate and detailed feedback, which helps students to identify and correct their errors more efficiently (Li et al., 2020; Zhang, 2020). Furthermore, AWE tools have been shown to promote autonomous learning, as students can receive instant feedback and work on revisions independently (Chen & Pan, 2022).

The integration of AWE tools in writing instruction also helps to address the challenges faced by educators in large classes. With the ability to process and evaluate large volumes of student writing, AWE tools enable teachers to provide timely feedback to all students, thus ensuring that each student receives the necessary guidance to improve their writing skills (Y. Wang et al., 2022). Moreover, the use of AWE tools can enhance student engagement and motivation by offering interactive and personalized feedback, which is crucial for language learning (Sun & Fan, 2022).

N. K. Thi & Nikolov (2022)conducted a study to examine the integrated use of Grammarly in a large class to support feedback provided by teachers. The results showed that Grammarly (an AWE tool) could successfully facilitate teacher feedback due to its effective feedback regarding surface-level errors. Moreover, a study conducted by (Link et al., 2022) supported the use of AWE as it positively impacts students' revision practices. Students seemed to use both content and surface-level language error feedback from the teacher and Criterion (an AWE tool).

Then, a study conducted by (Barrot, 2021) suggested that students who were exposed to Automated Written Corrective Feedback (AWCF) provided by Grammarly outperformed those who did not receive any AWCF. This finding supports the notion that Grammarly is a potential pedagogical tool in writing as it promotes the ability to notice errors, provides an adaptive metalinguistic explanation, and engages students in self-directed learning.

Because of the plethora of benefits, Automated Writing Evaluation (AWE) tools are now commonly used to complement the feedback provided by teachers and lecturers. These tools offer numerous advantages, including the ability to provide immediate, detailed, and consistent feedback on various aspects of writing such as grammar, punctuation, and style. AWE tools can handle large volumes of student writing, which is particularly beneficial in large classes where individualized feedback from teachers may be limited. They also promote autonomous learning by enabling students to receive and

act on feedback independently, thereby enhancing their writing skills over time (Aldosemani et al., 2023; Benali, 2021; Li et al., 2020; Y. Wang et al., 2022)

Despite these benefits, it is important to examine the trends in the studies on AWE tools, the specific tools used, and the types of writing they have been applied to in recent research. Understanding these trends can provide insights into how AWE tools are being integrated into educational settings and their effectiveness in improving writing skills. This examination can also identify gaps in the current research and suggest areas for future study. Thus, based on the available references and sources, research questions for this systematic review were formulated to analyze the trends and implementation of AWE in the university context. This analysis aims to provide a comprehensive understanding of how AWE tools are being utilized, the types of writing tasks they are applied to, and their impact on student writing outcomes. Additionally, the review seeks to explore the challenges and limitations associated with the use of AWE tools in academic settings.

The following are the research questions of this present study:

Research Question 1 (RQ 1). What are the trends of studies on automated writing evaluation in the university context?

Research Question 2 (RQ 2). How automated writing evaluation tools are used in the university context?

2. Method

2.1. Data Collection

This study provides a systematic review to demonstrate the evolving trends in the application of automated writing evaluation (AWE) tools, which are increasingly being adopted in educational settings to enhance the writing skills of students. AWE tools leverage sophisticated algorithms and natural language processing (NLP) technologies to evaluate and provide feedback on written texts, aiming to improve the quality of writing and streamline the feedback process traditionally offered by educators. To ensure the collection of comprehensive and relevant data, the study employed the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) methodology. PRISMA is a robust framework designed to enhance the clarity, transparency, and reproducibility of systematic reviews by guiding the meticulous identification, screening, and inclusion of pertinent studies. This method is critical in minimizing bias and ensuring the inclusion of high-quality research studies. Articles were sourced from three prominent databases renowned for their extensive coverage of educational and technological research: ERIC, Taylor & Francis, and Scopus. These databases were chosen due to their broad repository of peer-reviewed articles and their authoritative stance in the fields of education and technology. The search terms utilized to identify relevant studies were "Automated Written Corrective Feedback," "Automated Writing Evaluation," "Automatic Writing Evaluation," "Technology-based Writing Evaluation," and "Computer-generated Feedback." These terms were selected to cover a wide spectrum of terminologies and concepts associated with AWE tools, ensuring a thorough and inclusive search strategy that captures the various facets of automated writing assessmen.

2.2. Data Analysis

As the main focus of this study was writing evaluation for foreign language or second language learning, all studies related to corrective feedback for English as non-foreign or second language learners were excluded. In other words, studies that dealt with English as L1 were excluded. This study also focused only on the use of written corrective feedback in the higher education context because corrective feedback would significantly produce various results depending on the age groups. Besides, in general, it is uncommon to provide automated written corrective feedback to young learners especially those learning English as a foreign or second language (Klimova & Pikhart, 2022). The other exclusion criteria were the conference proceedings, non-experimental studies (theoretical, conceptual, or review studies), corrective feedback for speaking skills, and other languages than English.

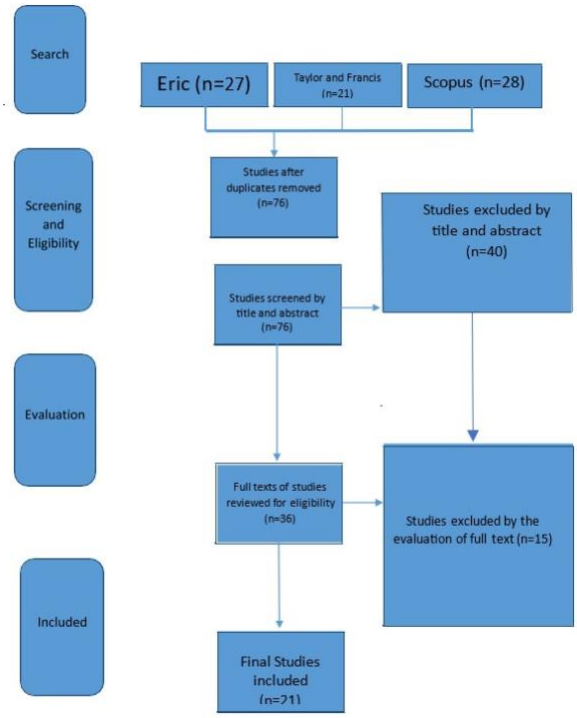

Figure 1. Flow chart of the systematic review process

Meanwhile, the criteria included in this study were multifaceted to ensure a comprehensive analysis. Firstly, the time span was a crucial factor, focusing on publications within a specific period to capture the most recent trends and developments. All articles indexed by the stated databases were considered, providing a broad and inclusive selection of studies. Additionally, only experimental studies were included to maintain a high standard of empirical evidence. Another key criterion was that the feedback provided in these studies had to be in the form of digital, electronic, or computer-mediated corrective feedback, reflecting the modern shift towards technology-assisted learning methods. The selected studies were

published between 2017 and 2022, ensuring the findings were based on up-to-date research within this five-year window, highlighting the latest advancements and applications in the field.

The dataset for this systematic literature review was collected from December 26th, 2022 to January 3rd, 2023. All relevant articles were collected from three different databases. They were then manually checked for their relevance to subcategories that were made based on the main aim of the study, namely seeing the trends of research related to the use of automated writing evaluation in the university context. The subcategories of research questions below are adapted from (Klimova & Pikhart, 2022; Turan & Akdag-Cimen, 2020)

Table 1. Subcategories of research questions

Research questions	Subcategories
RQ1 What are the trends of studies on automated writing evaluation in the university context?	Distribution of the studies by years: The reviewed articles were analyzed in terms of their indicated publication year in order to determine the number of studies per year
	Research methods used in articles: The reviewed articles were analyzed with the aim of defining the research methods used
	Countries of articles. The location of the study treatment was the main focus
RQ2 How automated writing evaluation tools are used in the university context?	Automated writing evaluation tools used in the university context
	The types of writing produced by the research participants

The first step in analyzing the data involved creating a detailed table using Microsoft Excel. This table was designed to categorize and organize the various subcategories of information derived from the research articles. The structure of the table allowed for systematic entry and easy retrieval of data, ensuring that every piece of relevant information could be accurately recorded and later analyzed.

Next, the table was populated with detailed information extracted from each of the selected research articles. A total of 76 research articles were initially collected from three different academic databases, ensuring a wide-ranging and comprehensive selection of studies. These databases were chosen for their relevance and authority in the fields of educational research and language learning.

After gathering these articles, a meticulous screening process began. Each article's title and abstract were carefully examined to determine their relevance to the specific focus of the study. This initial screening resulted in the exclusion of 40 articles, which were deemed not pertinent based on their titles and abstracts. The criteria for this exclusion included irrelevance to the research questions,

mismatch with the study's focus, and lack of alignment with the university context or second language and foreign language learning.

The remaining 36 articles were then subjected to a more in-depth review. However, upon closer examination, it was discovered that many of these articles did not meet the specific criteria for relevance. This phase involved a thorough reading and analysis of the content of each article, checking for the specific context of university-level education and the focus on second language and foreign language learning. Articles that did not align with these criteria were excluded from further analysis.

Ultimately, this rigorous selection process resulted in a final pool of 21 studies that were deemed highly relevant and suitable for further review. These studies were found to align perfectly with the research focus, providing valuable insights and data for the analysis. This careful and methodical approach ensured that only the most pertinent and high-quality studies were included in the final review, allowing for a more focused and comprehensive analysis of the use of digital corrective feedback in second language and foreign language learning contexts at the university level.

3. Findings

3.1. Trends in the Use of Automated Writing Evaluation Tools

Based on the subcategories of Research Question 1, the selected articles underwent a thorough examination according to several key factors: the year of publication, the research methods employed, and the countries where the studies were conducted. This multi-faceted analysis provided a comprehensive overview of the current research landscape, highlighting trends and patterns in the field.

First, the year of publication was considered to understand the temporal distribution of the studies. This helped identify whether interest in the research topic has grown, declined, or remained stable over the years. Next, the research methods used in each study were analyzed. This subcategory included a variety of methodologies such as qualitative, quantitative, and mixed-methods approaches. By examining the research methods, the analysis aimed to understand the different ways researchers have approached the topic, the types of data collected, and the rigor of the study designs. Lastly, the geographical distribution of the studies was examined by identifying the countries where the research was conducted. This subcategory provided insights into the global spread of research efforts, highlighting which regions have been most active in investigating the topic.

The findings based on each of these subcategories are presented below, offering a detailed analysis of how the selected articles contribute to the understanding of the research question. By breaking down the analysis into these specific subcategories, the study aimed to provide a nuanced and comprehensive overview of the existing literature, identifying gaps, trends, and areas for future research. This approach ensured that the review was not only thorough but also informative, highlighting the diversity and depth of research conducted in this field.

Distribution of the studies by years

Figure 2 below illustrates the distribution of studies related to automated writing

evaluation (AWE) in the university context over a span of six years. The bar chart visually represents the frequency of publication that indicates that the majority of articles meeting the specified criteria were published in 2021, with a total of five articles (n=5). In addition to the notable peak in 2021, the distribution of articles over the years shows a relatively consistent level of research activity. In 2017 and 2018, three articles (n=3) were published each year. The slight dip in 2019, with two articles (n=2), might reflect a temporary shift in research priorities or resource allocation. However, this was followed by a resurgence in 2020, with four articles (n=4) published, suggesting renewed interest and possibly the beginning of an upward trend in the exploration of AWE technologies.

The year 2022 saw a slight decline from the peak year, with four articles (n=4) published. This number, although lower than 2021, still represents a strong and sustained interest in the topic. The continued publication of studies in 2022 indicates that AWE tools remain a pertinent area of research, with ongoing investigations into their effectiveness, usability, and impact on student learning outcomes.

Overall, the bar chart provides a comprehensive overview of the temporal distribution of research articles on AWE tools in the university context. The data reveals not only the fluctuating yet sustained interest in this area but also highlights key years of increased research activity.

In summary, the bar chart below shows that the majority of articles relevant to the aforementioned criteria were published in 2021 (n=5). The numbers of articles published in 2017, 2018, 2019, 2020, 2021, and 2022 are (n=3), (n=3), (n=2), (n=4), (n=5), and (n=4) respectively.

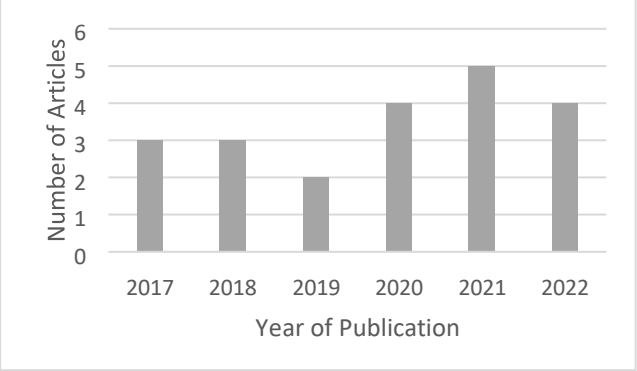

Figure 2. The number of research articles by year of publication

Research methodology of the reviewed studies

Most of the studies do not differ significantly in their methodological design and procedure, indicating a certain level of uniformity in how research in this area has been conducted. This consistency can be seen as both a strength and a limitation. On one hand, it allows for easier comparison and synthesis of results across different studies. On the other hand, it may suggest a lack of methodological innovation or diversity in approaches.

Interestingly, only one study among the reviewed articles employed a mixed-method research design. This approach combines both quantitative and qualitative methods, providing a more comprehensive understanding of the research problem by leveraging the strengths of both methodologies. The limited use of mixed-methods research in the reviewed studies highlights a potential area for future research to explore, as integrating multiple perspectives can often yield richer, more nuanced insights. Meanwhile, the majority of the reviewed studies were developed using either quantitative or qualitative methods. Specifically, 14 studies utilized quantitative methods. Then, six studies employed qualitative methods.

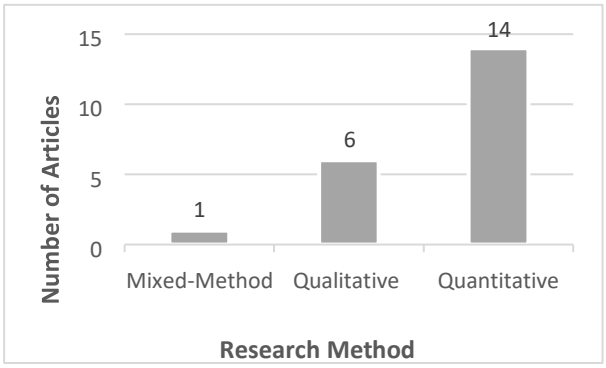

Figure 3. The research method used in the reviewed studies

Countries of the reviewed articles

From the data presented below, it is clear that the majority of studies were conducted in China (n=11). This dominant representation underscores the significant interest and investment in automated writing evaluation (AWE) tools within the Chinese educational context, particularly in the realm of English language learning and instructions. In contrast, the United States also shows notable activity in this area, albeit with fewer studies. Additionally, the data reveals a broader international interest in AWE tools, with studies conducted in a variety of other countries. Three studies were conducted across three different states in the USA. There is only one study in which the setting is Germany, Egypt, Hong Kong, Iran, Myanmar, Philippines, Taiwan, and the USA.

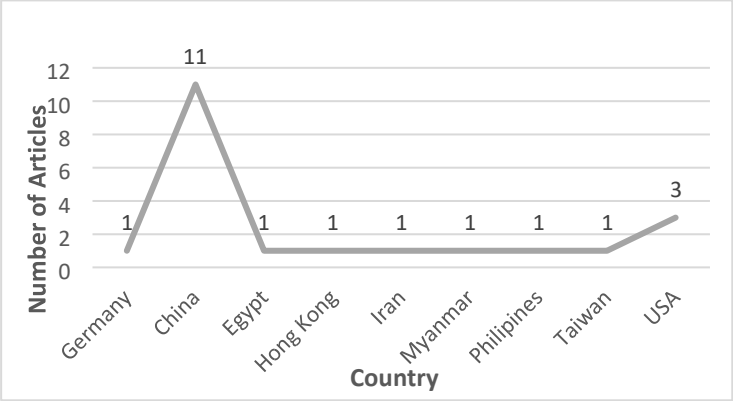

Figure 4. The number of research articles by country (where the research was conducted)

Types of tools and texts

To effectively address the second research question, the analysis was structured around two primary subcategories, each focusing on distinct yet complementary aspects of automated writing evaluation (AWE) tools. The first subcategory delves into the specific AWE tools that are commonly used in educational settings. Then, The second subcategory focuses on the types of writing produced by students who utilize these AWE tools. This involves an in-depth examination of the different genres, formats, and styles of writing that students engage in while using AWE tools.

3.2.Types of AWE tools commonly used in the university context

There are various AWE tools used by college students to improve their writing. The most commonly used application is Pigai (n=7), Grammarly (n=4), and Criterion (n=4). Self-developed applications/systems are those developed by a university to be later used by its students. There are three different studies that developed different AWE tools in the reviewed articles. Meanwhile, Cool Sentence Corrective Network, Cambridge Write and Improve, and AIM Writing was each presented by one study.

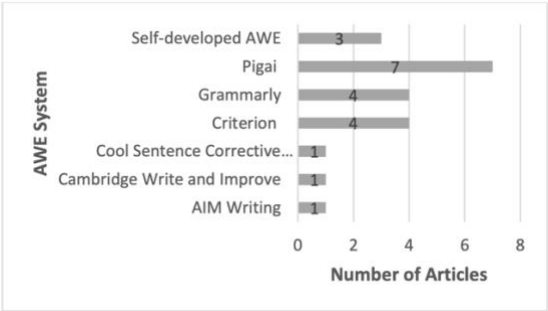

Figure 5. The number of AWE tools used in the reviewed articles

Types of texts produced by college students

Types of writing produced by college students using AWE tools are varied. AWE is mostly used in producing essays (n=7) in academic English and argumentative essay writing (n=3). Other types of writing are very varied, ranging from English business writing, and descriptive paragraph writing, to research paper writing.

Table 2. The types of writing produced by students

Types of Writing	f	Sample Article
Any Writing Drafts	1	(Ranalli, 2018)
Argumentative and Narrative Essays	1	(Thi & Nikolov, 2022)
Argumentative Essay	3	(Barrot, 2021; W. Li et al., 2020; Link et al., 2022)
College English Test Band 4 Writing Section	1	(Zhai & Ma, 2021)
Descriptive Paragraph	1	(Shang, 2022)
English Business Writing	1	(Tsai, 2019)
E-Portfolio	1	(Z. Li et al., 2017)
Essay Writing	7	(Chen & Pan, 2022; Jiang & Yu, 2022; R. Li et al., 2019; Waer, 2021; Wang et al., 2022; Z. V. Zhang, 2017; Z. (Victor) Zhang & Hyland, 2018b)
Journal Article Review (400 Words)	1	(Z. (Victor) Zhang, 2020)
Research Paper-Introduction Part	1	(Guo et al., 2021)
Article Summary	1	(Koltovskaia, 2020; Strobl, 2017)
Task 1 IELTS Academic Writing	1	(Gao & Ma, 2022)

4. Discussion

In this present study, there were 76 articles collected from three different databases (Eric, Taylor & Francis, and Scopus). All of them were further examined to find information related to determined subcategories. In terms of articles published within the time restriction, it was found that during the last three years (2020-2022), the number of articles published increased.

Meanwhile, in terms of the methodology of the reviewed studies, most of the studies do not differ in their methodological design. The majority of the studies were conducted using the quantitative research design because most of them are in the form of experimental studies. Meanwhile, there are six qualitative studies found in the analyzed articles. These qualitative studies made use of case study and explorative study research designs. Only one out of 21 studies employed the mixed-research design. It is a classroom-based study that employed a mixed-methods approach to explore both short-term and long-term effects of Criterion feedback on ESL students' development of grammatical accuracy. In

this study, quantitative data were collected from error counts of students' writing products, while qualitative data were collected from semi-structured interviews.

Out of 21 identified studies, most of them were conducted in Asia (China, Hong Kong, Iran, Myanmar, Philippines, Egypt, and Taiwan), and there is only one study conducted in Germany. The majority of the reviewed studies on automated corrective feedback for ESL and EFL learners were conducted in China. Although there are three studies that were carried out in the USA where English is commonly learned as a first language, the research participants were from outside of the USA, and English is taught as EFL/ESL in the research, so those three articles were still included in this study.

In terms of the types of automated writing evaluation tools, Pigai is the most commonly used by university students. This AWE system is managed by a Chinese company and used by tens of millions of students in Chinese universities (Zhang & Hyland, 2018). The tool provides holistic scoring, a ranking, four-category descriptors, and end comments as well as corrective feedback. Moreover, it is a rich source of data as it not only saved drafts and AWE feedback but also recorded the submission time of each draft.

Then, the second most used AWE system is Grammarly and Criterion. The free version of Grammarly provides feedback on spelling, punctuation, grammar, and conventions, including spacing, capitalization, and dialect-specific spelling (Koltovskaia, 2020). This tool gathers a lot of interest in recent years because it is free and instantly provides feedback for improvement once a text is uploaded online. Meanwhile, Criterion is a popular AWE tool that provides messages every time it detects a fragment error. It does not only provide specific feedback, but also includes some component of the student text in its formulation, either in its recommendation to use a particular word or by recommending a specific operation with reference to a highlighted textual feature (Ranalli, 2018). Out of 21 reviewed articles, three of them tried to investigate the effectiveness of self-developed AWE. Thus, there was no name for the product being developed. The AWE tools were developed to firstly be used by the internal community of the universities.

Related to the types of writing produced by students, essay drafts are the most commonly reviewed using AWE. The results confirm that essay writing is usually produced in ESL/EFL writing classes since in most circumstances, course instructors left a writing prompt for students at the end of a class and graded those essays within weeks. Scarcely did the lecturers spare a proper period of time to talk about the problems in the writings (Chen & Pan, 2022). This kind of condition makes AWE very meaningful to be used in writing classes as the potential substitution of lecturers' lower order (grammar, punctuation, mechanic) feedback. Furthermore, AWE was also proven to be effective in revising the drafts of writing tasks in an English proficiency test (IELTS) which required participants to summarize past data in tables/graphs and report on the phenomena/trends (Gao & Ma, 2022)

5. Conclusion

The findings of this review study point to the trends of Automated Writing Evaluation (AWE) tool use in the university context, which have a considerable impact on the potential reliable aid to improve students'

learning outcomes, particularly in writing class. These tools offer immediate feedback and allow students to revise their work multiple times before submission, fostering a more iterative and reflective writing process. Besides, it might have a long-term effect on the improvement of the practice of teaching writing in the higher education context. Instructors can use AWE tools to efficiently assess large volumes of student writing, enabling them to focus on more personalized feedback and instruction.

Overall, this review presents what is currently known regarding the application of AWE in English as a Second Language (ESL) and English as a Foreign Language (EFL) classes. These tools have been shown to support language learners by providing consistent and objective evaluations, which can help reduce the workload on teachers and enhance the learning experience for students. However, this study has not examined the potential benefits and drawbacks of the use of AWE.

It is crucial to consider both the positive aspects and the limitations, such as the potential for over-reliance on technology or the possible lack of nuanced understanding in the feedback provided by AWE systems. Therefore, further research activity with more comparable data may be conducted to investigate the effectiveness and maybe drawbacks of automated writing evaluation tools in general. Such studies could focus on a variety of contexts and student populations to provide a more comprehensive understanding of how AWE tools impact writing education. Additionally, exploring the integration of AWE with traditional teaching methods could yield insights into best practices for combining technology with human instruction.

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