The Study of Junior High School English Teachers' Application of AI-Assisted Text Analysis Module and Its Teaching Effectiveness

Introduction

Artificial intelligence (AI) refers to a type of algorithms or computerized systems that resemble human mental processes of decision-making (Wang, 2021). With the rapid development of AI, we have entered the Fourth Industrial Revolution, which has brought widespread digital transformation with advanced and broadened technologies including AI. To help students prosper in a world full of AI applications, it is important for us to offer students sufficient AI-integrated learning opportunities across different subjects (Kim, 2022; Sun, Ma, Zeng, Han, & Jin, 2023). Sumakul, Hamied and Sukyad (2022) suggest that AI could offer advantages in education, and AI-based applications have been developed for teaching and learning. Related studies (Celik, Dindar, Muukkonen, & Järvelä, 2022; Gupta & Bhaskar, 2020; Huang, Samek, & Shiri, 2022; Monteith, Noyce, & Zhang, 2022; Walia & Kumar, 2022; Xu & Margevica-Grinberga, 2021; Yau, Chai, Chiu, Meng, King, & Yam, 2023) indicate that AI has significant positive effects on teaching, but it still presents challenges for teachers. For example, research findings indicate a promising future for AI in English language teaching (ELT). The use of AI in ELT has produced positive outcomes, including optimization of English language skills, translation, assessment, recognition, attitude, and satisfaction (Sharadgah & Sa'di, 2022). The above text highlights the growing importance of AI in education, particularly in providing students with AI-integrated learning opportunities. Although AI has been shown to have positive effects on teaching, there are still challenges for teachers to overcome. The use of AI in English language teaching has produced promising results, including optimizing language skills and improving student attitudes and satisfaction. As AI continues to develop, it is important for educators to stay informed and adapt to the changing landscape of education.

The integration of AI into K-12 teaching is becoming a necessity due to the rapid advancement and deployment of AI technologies. When teachers apply AI in instructional design, it is essential to consider students' perspectives. However, there have been very few studies investigating students' perception of the integration of AI into teaching. In the context of Taiwan, taking the Taiwan Electronic Theses and Dissertations System as an example, research on teachers' application of artificial intelligence in English language teaching appears to be limited, and there is a lack of studies on junior high school teachers and students as research subjects. In light of this, this study investigates the current status of junior high school students' perceptions of English teachers effectively integrating AI text analysis modules, such as word clouds, keyword frequency, and intelligent classification, into their

instructional design. Since 2015, there have been continuous studies on “text mining” both domestically and internationally in the field of education. These studies have focused on the practical applications of text mining, such as collecting and analyzing large amounts of textual data from various sources, including online platforms and emails. These findings have been incorporated into the interactive teaching process, allowing students to gain a deeper understanding of the content through post-classroom analysis and experimental results (Zanini & Dhawan, 2015). Yan (2021) proposed using text mining to automatically analyze the vast amount of text messages on online discussion forums, in order to provide real-time information related to the nature of the text content to teachers who are teaching the course. This allows teachers to adjust their teaching methods based on the discussion and interaction among students. There is an increasing demand for text mining applications in education, and Yang, Kinshuk and An (2023) have shown that massive amounts of educational texts can provide rich information support for various educational aspects. However, the large and constantly increasing amount of text data makes it increasingly difficult for teachers to manually analyze this information.

Therefore, the development and application of AI technology tools has become a solution. If teachers can effectively integrate text mining into their teaching process and improve the learning experience for students, as well as reduce the discrepancy between the time spent waiting for teachers to review and organize teaching materials, it should positively affect learning effectiveness. The “AI Text Analysis Module” within the “HiTeach Smart Teaching System” allows learners to provide qualitative data about the text category through mobile devices such as smartphones or tablets. Through the built-in algorithmic technology of the system, it can immediately produce word clouds, the frequency of repeated keywords, and the classification of designated groups. The system also allows for manual correction and subsequent application and organization of the analyzed data, enabling teachers to utilize the content of learners' responses during the teaching process as a reference for their teaching decisions.

The Purpose of the Study

In foreign countries, AI has been making a revolutionary and profound impact on the teaching of English as a Foreign Language (EFL) for decades. However, despite these recognized advancements, teachers have many reservations and objections to the adoption of AI-based applications. The findings indicated that effectiveness and efficiency were the most influential factors motivating teachers to adopt AI-based applications in EFL (Du & Gao, 2022). Recently, researchers have tended to use such data mining techniques as text mining to develop learning systems for supporting teachers' instruction and students' learning. We also found that classification, text

mining, and clustering are major data mining techniques researchers have used (Shin & Shim, 2021). The AI-assisted sentence analysis module of HiTeach used by the English teachers in this study during the teaching process involves the application of text mining techniques. In a digital teaching environment, teachers often use various digital tools to collect students' text-based responses, tasks, or assignments. The large amount of textual data can then be classified, analyzed, and organized using HiTeach 5's AI-assisted sentence analysis module, which not only reduces teaching burden but also significantly enhances teaching decision-making effectiveness. Therefore, the purpose of this study is to empirically investigate junior high school students' perceptions of English teachers' use of AI-assisted text analysis module. The main research questions are: What is the current teaching effectiveness of English teachers' use of AI-assisted text analysis module functions (word cloud, keyword frequency, intelligent classification) in the perception of junior high school students? What is the benefit of English teachers using "word clouds, intelligent classification, and keywords" during class for students' learning of English?

Theoretical Framework

Meaning of AI-assisted Text Analysis Module

The development background and demand of the AI-assisted Text Analysis Module originate from the process of applying various information technologies in interactive classrooms, where the teaching end proposes open-ended questions and collects textual feedback from the learning end through questioning. This interactive process can record many valuable data and even enable further analysis and research. Compared with the Interactive Response System (IRS) that has been used for many years, the technology used by the AI-assisted Text Analysis Module to collect textual feedback is more advanced. This technology can be applied to more advanced classroom tasks, not only to further understand the individual learning process of learners but also to provide more comprehensive decision-making references for teachers in their teaching decisions.

Although text mining research has various applications in different fields, its primary goal is to improve efficiency in recognizing and classifying unstructured text data. However, its application in educational practices is relatively uncommon. Yao and Xu (2022) proposed a text analysis system that combines genetic algorithms to accurately extract useful information from English texts. This technology is widely used in fields such as artificial intelligence, machine learning, data search, and optimization problem-solving. Xu, Wang, Liu, and Xu (2021) also proposed a text analysis technique for the communication field, specifically for rapid news classification. These applications not only save time in traditional manual judgment but also make text application systems more flexible. If educators can effectively use

such technology in the field of education, it can significantly reduce the time teachers spend on post-classification of texts, allowing students to receive immediate feedback in the learning process and promoting the interaction between teaching and learning. Yang, Kinshuk and An (2023) have demonstrated that text mining technology is a powerful tool for automatically analyzing large-scale text and generating insights from it. However, many educational researchers are not fully aware of the usefulness of text mining technology and how to apply it to teaching and research. The application of such technology in educational research is becoming increasingly popular and essential.

The AI-assisted text analysis module used in this study enables teachers to ask questions and allows students to provide qualitative data on text categories through mobile devices such as phones and tablets. The system uses built-in algorithms to immediately produce three functions: "smart classification, keyword frequency, and word clouds," which provide repeated occurrences of keywords and categorize them into specified groups. The system also allows for manual correction and subsequent application and organization of the data. This enables teachers to effectively utilize student responses during the teaching process and use them as a reference for future teaching decisions.

Three Functions of the AI-Assisted Text Analysis Module

Word Cloud

A word cloud is a type of image that visualizes key words extracted from unstructured text data. Some people refer to it as a tag cloud, where each tag's text is generally an independent word that can be presented in varying font sizes or colors depending on its importance. The creation of a word cloud combines the applications of data visualization and natural language processing (NLP), requiring the ability to quickly compute and access text interfaces, as well as the ability to draw screens freely through programming interfaces (Yang, 2019).

Analysis of Keyword Frequency

By applying keyword analysis techniques in text mining, important keywords that are not functional or redundant are extracted from the collected unstructured text data, processed through word segmentation, and classified and presented. The most frequently occurring keywords will be sorted towards the front-end, and the lower the ranking, the less frequent the occurrence. If the text data is diverse, a visualization of the long-tail effect will appear. Liu (2018) pointed out that the long-tail effect is a concept that subverts the traditional 80/20 rule, meaning that all non-mainstream markets combined are actually greater than the mainstream market, and the tool that accelerates the long-tail effect is the internet and technological applications. Although not yet widely used in the field of education, in encouraging students' adaptive and

diversified development, if it is already part of the daily routine in the classroom, this is a more meaningful encouragement for diverse opinions to be voiced, and this part serves as an important conceptual and theoretical basis for this feature.

Intelligent Classification of Text Messages

This feature is an application of association rule analysis and co-occurrence analysis in text mining techniques. After the teacher asks the filling question, all unstructured text data returned by the students is intelligently and automatically classified, effectively and immediately presenting the types of overall feedback, which can be divided into three to four clear main directions. The instructor can also make manual adjustments to the number of classifications or classification revisions after viewing the classifications. The overall process is also a valuable part of the teaching process. Chang, Chang, and Yu (2021) pointed out that co-occurrence analysis and association rule analysis first set up text-assisted segmentation in the text processing, then convert the corpus into structured styles, i.e., quantitative forms, and then apply two-stage clustering analysis techniques to automatically classify the structured data and further demonstrate the consistency of that category in hook classification.

Research on the Effectiveness of Teaching

This study further organizes the literature related to teaching effectiveness, focusing on literature related to the past five years, such as teacher information literacy, knowledge management, professional learning communities, and teacher culture. In recent years, various educational reforms in Taiwan have mainly aimed to improve the teaching effectiveness of teachers, such as curriculum reforms in schools or regions and the professional development of teachers. Some studies have pointed out that the neglect of the original teacher culture during these reforms has become a key problem (Hsu, 2022). To effectively enhance teacher teaching effectiveness, teachers should be encouraged to pursue professional growth and development or strategically enhance their motivation to improve themselves. When teachers want to optimize their teaching and improve their motivation to continue their education, their professional growth and teaching effectiveness will have a linked effect. The better and more proactive teachers are in their professional growth, the higher their teaching effectiveness will be (Tsai, Chen, & Chen, 2020). Other studies have suggested that teachers should actively participate in various forms of learning and self-improvement courses throughout their teaching careers, especially those related to information literacy or the integration of information technology into teaching, in order to improve their personal information technology knowledge, skills, and attitudes, promote personal self-realization, and enhance teaching quality and effectiveness, in order to achieve the ideal goal of teaching. This is one of the connotations of teacher

professional growth (Yeh & Chou, 2020).

The addition of the technology field in the “108 Curriculum and Guidelines” not only formally includes topics such as programming into the required courses, opening up a new milestone in education, but also allows digital teaching to be widely adopted by teachers. Therefore, studying the benefits and help of digital teaching for students' knowledge acquisition has become one of the important research directions in teaching. Teachers' knowledge management and innovative teaching not only contribute to the increase of teaching effectiveness but also to the efficiency of administrative operations and school management. Moreover, teachers' knowledge management has good predictability for teaching effectiveness, especially in the area of knowledge application. Studies have shown that teachers' knowledge management ability and teaching effectiveness have a positive correlation (Hung & Chang, 2019; Hsing, 2020).

The Dimensions of Teaching Effectiveness

Based on a comprehensive review of instructional effectiveness studies (Kareem, Thomas, & Nandini, 2022; Yang, 2022; Liang, Sha, & Chen, Chiu, 2020; Yeh & Chou, 2020; Hung & Chang, 2019), this research divides instructional effectiveness into five dimensions: effectiveness of instructional materials and presentation, effectiveness of teaching methods and strategies, effectiveness of teacher-student interaction (including technology application and situational context), effectiveness of instructional assessment, and effectiveness of classroom management in utilizing instructional time. This research will explore the relationship between instructional effectiveness and English language teachers' integration of technology in instructional design through these five dimensions. The details of each dimension are as follows:

1. **Effectiveness of instructional materials and presentation**: Refers to the teacher's ability to systematically plan and design the curriculum and teaching materials and present them in an organized manner during the instructional process.
2. **Effectiveness of teaching methods and strategies**: Refers to the teacher's ability to use engaging and interactive teaching methods, stimulate students' learning motivation, employ effective and diverse teaching techniques or methods, and provide opportunities for bidirectional interaction and feedback to promote effective learning.
3. **Effectiveness of teacher-student interaction in incorporating technology and situational context**: Refers to the teacher's ability to integrate information technology during the instructional process, create a comfortable and relaxed learning environment for students, encourage active discussions and exchange of opinions with peers and teachers.

4. **Effectiveness of instructional assessment**: Refers to the teacher's ability to prepare assessments that align with instructional objectives, arrange appropriate timing for students to conduct immediate and effective evaluation of their learning, and provide teaching feedback based on the results, enabling multimedia and technology-assisted instructional decision-making.
5. **Effectiveness of classroom management in utilizing instructional time**: Refers to the teacher's ability to foster a harmonious classroom atmosphere, allocate appropriate time for course content, promptly and effectively respond to students' questions and eliminate distractions unrelated to teaching activities, and master the rhythm of teaching activities, promoting students' learning throughout the process.

Research Method of the Primary Study

Research Sample

The present study adopted a two-stage sampling method. In the first stage, purposive sampling was used to select two junior high schools in Taoyuan City. In the second stage, cluster sampling was employed to select two classes from each school, resulting in a total of 4 classes and 100 students. Out of the 100 questionnaires distributed, 92 were returned, and after excluding 12 invalid responses, 80 valid questionnaires were obtained, yielding a response rate of 80%.

Research Instrument

The "Survey of the AI-Assisted Sentence Analysis Module and Teaching Effectiveness for Junior High School English Teachers' Technology Application" used in this study was adapted from "The Teacher Efficacy Scale" revised by Nie, Lau, and Liau (2012) and "The Survey of Behavioral Patterns and Teaching Effectiveness of Technology Integration fo Elementary and Junior High School Teachers" compiled by Hsieh (2020). The "Teaching Effectiveness Scale" in the questionnaire includes five dimensions: "effectiveness of content and presentation of teaching materials," "effectiveness of teaching methods and strategies," "effectiveness of teacher-student interaction (technology application and situational creation)," "effectiveness of teaching evaluation," and "effectiveness of class management through the efficient use of teaching time." Considering that the questionnaire was designed to measure the perception and attitude of junior high school students, an even-numbered scale was used to achieve higher validity, as suggested by Wu (1996). Thus, a 4-point Likert scale was used in this study to measure students' perception of the "Teaching Effectiveness Scale." The questionnaire consists of 15 items with a Cronbach's Alpha value of .931, indicating good reliability. In addition, there were three open-ended questions in the questionnaire asking students to describe how using functions such as "word clouds, intelligent classification, and keywords" in class helped them in their

English learning when the teacher asked for "standard answers," and when the teacher asked "open-ended" questions.

Findings and Discussion

Descriptive Statistical Summary of "Teaching Effectiveness" for Teachers

The average perception of teaching effectiveness among junior high school students is 3.36, which falls between "very well" and "well". Among the different aspects, "Effectiveness of Content and Presentation of Teaching Materials" (M=3.59) received the highest score, followed by "Effectiveness of Teaching Evaluation" (M=3.34), "Effectiveness of Managing Classroom Time" (M=3.32), "Effectiveness of Teaching Methods and Strategies" (M=3.29), and "Effectiveness of Teacher-Student Interaction with Technology and Context" (M=3.23). The mean scores for all aspects, falling between "very well" and "well," indicate that students have a positive perception of the teaching effectiveness of teachers who integrate technology.

Analysis of Differences in Teacher Efficacy in Teaching

A comparative analysis was conducted on the differences in teacher's teaching effectiveness perceived by students based on their background variables in this study. Overall, the results reached a significant level (t=-2.98, p<.05), indicating that students' perception of teacher's teaching effectiveness varied significantly due to gender differences. In terms of each sub-dimension, in "effectiveness of teaching materials and presentation" (t=-2.731), "effectiveness of teaching methods and strategies" (t=-2.308), "effectiveness of integrating technology and situational interaction between teachers and students" (t=-2.139, p<.01), "effectiveness of teaching evaluation" (t=-2.953, p<.05), and "effectiveness of managing classroom time effectively" (t=-2.669), two sub-dimensions had t-values that reached a significant level, indicating that students of different genders have different views on teacher's teaching effectiveness in each sub-dimension. In summary, students of different genders perceive teacher's teaching effectiveness differently in overall and in the sub-dimensions of "effectiveness of integrating technology and situational interaction between teachers and students" and "effectiveness of teaching evaluation," as indicated by the t-values that reached a significant level. In terms of "English learning duration" of the students, both overall and in each aspect, there is no significant difference in the perceived "teaching effectiveness" of teachers among students with different English learning durations. As for the "duration of exposure to technological devices" of students, there were no significant differences in the "teacher's teaching effectiveness" for all aspects and each subcategory when looking at the differences in exposure duration to technological devices.

Analysis of the Relationship between the Integration of Information Technology and the Effectiveness of English Language Teaching

The degree of integration of instructional design will affect learning effectiveness (perceived by the learner)

The analysis shows that incorporating AI text analysis tools, such as word clouds, into teaching design and strategies can effectively motivate students' learning, as evidenced by their positive qualitative feedback and support for increased use by teachers. Students responded positively to the use of word clouds, with occasional mentions of keyword frequency, although they found the use of intelligent classification to be unclear. However, teachers were less familiar and used the "intelligent classification" feature less frequently, which was also reflected in students' feedback, indicating a lack of interest and some students explicitly stating that it did not help with their learning (which echoes the first point).

For different levels of learners, there are different perceptions of the learning effectiveness of immediate feedback

The provision of immediate feedback, such as through the use of word clouds, by the teaching side can make the learning side aware of the similarities and differences between themselves and their peers. Open-ended questioning types can make lower-scoring students more willing to participate in class, while higher-scoring students may become aware that they may not necessarily have better thinking and expression skills when facing questions without a standard answer. Students not only value the importance of their responses (cannot answer recklessly), but also discover the same helpfulness in their English learning. Many students found it impressive to discover different answers, and they found it interesting and helpful. This is because they realized that what they thought was different from what everyone else thought, or that what they thought was the same as everyone else's. Through the integration of AI text analysis modules by the teacher, peers also begin to appreciate each other's responses or reflect on their own responses, and even become more focused on classroom instruction. The provision of immediate feedback, such as through the use of text clouds, by the teaching side can make the learning side aware of the similarities and differences between themselves and their peers. Open-ended questioning types can make lower-scoring students more willing to participate in class, while higher-scoring students may become aware that they may not necessarily have better thinking and expression skills when facing questions without a standard answer. Students not only value the importance of their responses (cannot answer recklessly), but also discover the same helpfulness in their English learning. Many students found it impressive to discover different answers, and they found it interesting and helpful.

Different Question Types Elicit Different Levels of Learner Engagement

Asking questions with a standard answer can enhance learning and provide guidance. Open-ended questions can encourage creative responses and boost

confidence. When standard-answer questions are integrated with AI text analysis in teaching, students feel more confident in answering because they can learn from their peers' answers if they get it wrong, rather than relying solely on the teacher's explanation. In terms of responses to open-ended and standard-answer questions, students generally have a more positive reaction to open-ended questions and feel more pressured when there is a standard answer.

AI-Assisted Text Analysis Module Enhances Teaching and Learning Efficiency in Synchronization

As the teaching content is presented on the learning platform, the learners will "sync" with the teaching side to think of similar or similar questions, interpret and evaluate the classification of AI together, and acquire the skills of applying and utilizing technological functions. Some learners are even more proficient than the teachers in this regard. Therefore, the AI-assisted text analysis module not only helps teachers conduct efficient teaching but also enables learners to learn more effectively.

Conclusions and Implications

This study focuses on the use of educational technology tools to assist teaching in English classes at the junior high school level. Specifically, the effectiveness of the "AI-assisted sentence analysis module" of an artificial intelligence teaching system is examined. The study also explores the choices and teaching effectiveness of English teachers in junior high schools in the trend of integrating information technology into teaching. Based on the comprehensive study, the important finding is that the average perceived teaching effectiveness of the 80 junior high school students in this research is 3.36, ranging between "very suitable" and "suitable". In terms of various aspects, "the effectiveness of teaching content and presentation" is the highest, followed by "the effectiveness of teaching assessment", "the effectiveness of managing class time efficiently", "the effectiveness of teaching methods and strategies", and "the effectiveness of incorporating technology and situational interaction between teachers and students". From the descriptive statistics of junior high school students' perceived teacher instructional effectiveness, it can be inferred that the average values in each aspect range between "very suitable" and "suitable", indicating that students have a good perception of teachers' teaching effectiveness in integrating technology. There are significant differences in students' "gender" in the overall level of teacher's teaching effectiveness and in the three aspects of "incorporating technology and situational interaction between teachers and students", and "the effectiveness of teaching assessment". This indicates that different genders of students have significant differences in their perception of teachers' teaching effectiveness, especially in the process of interaction between teachers and students and in the aspect of teaching assessment. There are no significant differences in the "English learning time" and

"the duration of exposure to technological devices" among students in both the overall level of teacher's teaching effectiveness and the various sub-levels. The goal is to provide English teachers with insights into teaching design and the use of educational technology tools based on the results and findings of this study, and to provide relevant institutions such as teacher education programs with a reference.

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