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Leveraging AI Tools for Discourse Analysis in Early Childhood Bilingual Education: Enhancing Language Development

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Abstract. The implementation of AI tools in education has become increasingly popular and brought transformative potential, particularly in the field of language education because of its powerful functions on designing immersive and personalized activities and offering real-time feedback. This study explores the role of AI tools in discourse analysis and the impact on enhancing bilingual skills among early childhood students. It investigates two key questions: (1) How do AI tools impact young children's bilingual skills in early childhood classrooms? (2) How can discourse analysis of AI tools assist educators with bilingual teaching? A qualitative case study, including an in-depth interview with a bilingual educator, reveals insights into the effectiveness of AI tools in promoting bilingual language acquisition and engaging young learners in meaningful and enjoyable learning environment. Furthermore, the discourse analysis of AI tools offers immediate, actionable insights on each student's academic performance, helping educators better understand the language learning process and the specific challenges students face. However, considerations and challenges of AI in education, such as privacy risks and misuse, still need to be considered. The findings of this study bridge the gap and highlight the potential for discourse analysis of AI tools in early childhood bilingual education. Further study can focus on exploring other AI tools in bilingual education and conducting long-term research with a large example size.

Keywords: AI tool, early childhood bilingual education, discourse analysis

1. Introduction

The rapid growth of technology, especially Artificial Intelligence (AI), has brought huge changes to today's world. AI is the term for digital systems that use training on a broad basis to learn and self-correct [1]. Implementation of AI appeared across a wide range of industries, including healthcare, finance, transportation, and education, ushering in a new era of transformative innovation [2]. The application of AI in education has significantly evolved over the past few decades. Today, AI-based learning has been increasingly used in both K-12 and university contexts [3]. AI is revolutionizing education through personalized learning, automated grading, virtual classrooms, and intelligent content creation. It benefits education in multiple ways, including the educational process and the educational scope and content, assisting educators with routine functions, and modifying what type of education is required [4]. With the release of AI-powered tools such as ChatGPT, that use large-scale language models to generate human-like text, researchers and scholars saw the potential of AI in language teaching and learning. AI's capabilities make language learning more efficient, effective, and accessible, breaking down educational barriers and opening up new possibilities for learners worldwide.

Consequently, AI brings new changes and potential to future education, especially literacy education. Given the increasing attention to AI in language teaching and learning, it is necessary to systematically discuss the effect of AI-based tools and technology in literacy education. Furthermore, according to EC English [5], there are approximately 750 million English Language Learners worldwide. Meticulous Market Research [6] estimates that with the growth of AI and robot technology and e-learning, the global English language learning market will be worth $88.1 billion by 2031. Therefore, it is essential to have a broader view of how bilingual or multilingual speakers can enhance their language skills by using AI tools and technology. Discourse analysis was first introduced by Harris [7] as a method to analyze a kind of speech. With further studies on discourse analysis, researchers realized its effectiveness in analyzing bilingual discourse. Because of what discourse analysis may reveal about the process and suggestions regarding second language education, it has become an increasingly popular analytic approach to academics, exploring second language development [8]. As young children are at the beginning stage of exploring their language systems and best period to learn bilingual or multilingual, it is necessary to study how discourse analysis can help them learn languages

effectively and how AI can be used as assistive tools to help educators analyze discourse and improve their teaching. This study aims to investigate the effect of AI tools on discourse analysis in bilingual education for students in early childhood classrooms. Specifically, it explores how AI-driven tools can provide interactive learning and enhance bilingual skills among young children, making language learning more effective and interesting. This study plans to answer two research questions:(1) How do AI tools impact young children's bilingual skills in early childhood classrooms? (2) How can discourse analysis of AI tools assist educators with bilingual teaching? This paper includes four parts. In the first section, I define the discourse analysis and theoretical foundation of discourse analysis. In the second section, I review the historical view of AI in language learning to understand the AI-based learning technologies that teachers use in the classroom, the effect of these tools on students' language learning, and the considerations of using AI in teaching and learning. In the third section, I discuss the effects of AI tools on young children's bilingual skills and the effects of discourse analysis of AI tools in bilingual teaching through a qualitative research method. In the fourth section, I summarize the main arguments covered in this study and point out suggestions for future research directions.

The research on the effect of AI tools on discourse analysis in early childhood bilingual education holds significant importance and potential impact. Based on the literature review, there are few studies focused on young children. Most researchers pay attention to upper-level or university students. However, early childhood is a critical period for language acquisition, and practical literacy skills are foundational for academic success and social integration. It is essential to study how AI can help children acquire bi-languages. Besides, by leveraging AI tools, educators can provide young children with more interactive, personalized, and responsive learning experiences. This research explores This research explores AI tools' role in discourse analysis, offering real-time feedback, conversational practice, and contextual understanding, which are essential for developing proficiency in a new language. The findings could lead to innovative educational strategies, improved curriculum design, and enhanced teaching methodologies that support young bilingual children in becoming confident and competent communicators, thereby setting a solid foundation for their future educational journey. Furthermore, the findings of this study can provide first-hand information and data for policymakers and technology developers to better understand the current status, trends, and potential of AI applications in education, especially for young bilingual children. This can inform both decision-making and strategic planning in the education and policy domains.

2. An Issue of Definition

This paper mainly focuses on the implementation of AI tools in the bilingual teaching and learning process and uses discourse analysis to understand the effect of AI tools on students' bilingual skills. In this section, I give a clear definition of discourse analysis and the theoretical foundation of discourse analysis in language education.

2.1. Definition of Discourse Analysis

Harris [7] first pointed out the concept of discourse analysis. He views discourse as a kind of speech, concentrating on the structural aspects of text. Later, Hymes [9] created the "ethnography of speaking," emphasizing the importance of sociocultural context and the combination of culture in language use. He believes discourse analysis is to understand the meaning of communication and the process of the language use. His finding marked the framework for using discourse analysis in educational settings. Brown and Yule [10] further studied this term. They agree that discourse analysis refers to the analysis of language in use, but it cannot be limited to describing language forms without regard for the aims or functions they are intended to fulfill in human affairs. Therefore, the discourse analysis should be transactional and interactional [10].

Recently, more academics expanded discourse analysis in educational settings to encompass a variety of methodologies and multidisciplinary influences, drawing on sociology, anthropology, psychology, and communication studies [8], having a more comprehensive understanding of discourse analysis in education. Tannen et al. [11] hold the view that discourse analysis in the school context differs from discourse in the home setting. To a large part, the fabric of schooling is made up of language interactions. Analyzing the usage of discourse in school can be divided into three approaches: the interactional approach, the critical approach, and the systemic functional approach [11]. Kibler's [12] study proved Tannen et al.'s [11] argument by using an interactional approach to analyze adolescent emerging bilingual students' discourse performance during an informal teacher-student conference. The findings indicated that discourse analysis focuses on the challenges teachers confront when understanding students' restricted contributions and the interactional and interpretative responsibilities teachers play in students' learning and language acquisition process. Kibler [12] emphasized the usefulness of the interactional approach of discourse analysis in helping teachers explore new interaction methods with students and enabling researchers to be aware of bilingual student's long-term language development. Moreover, Bonyadi [13] reviewed multiple published papers focusing on mainly three main approaches to discourse analysis: critical discourse analysis (CDA), descriptive discourse analysis (DDA), and pedagogical discourse analysis (PDA). CDA in education could help students become critical thinkers and acquire the target language's fundamental linguistic patterns. Practitioners used DDA to describe language above the phrase while considering the relevant educational environment, and PDA investigated the impact of various discourse characteristics on language instruction [13]. Temple Adger and Wright [8] regarded classroom interaction as a cultural practice. They believe that discourse analysis has been helpful in identifying the educational struggles of children from certain groups in classroom practices, significantly

when the teacher's cultural background and the school's dominant culture differ from that of the students, which aligns with some situations that bilingual students may face at school when they share different cultural backgrounds with teachers or classmates.

Therefore, according to the present review, discourse analysis is effective and meaningful for teachers and researchers since they can learn how students develop their language system and use their social words to express their feelings and understanding, especially in the learning process of bilingual learners.

2.2. Theoretical Foundation of Discourse Analysis

Discourse analysis has significantly tested and expanded Lev Vygotsky's [14] sociocultural theory [8]. Vygotsky [14] highlighted the critical significance of social interaction and cultural environment in cognitive development and emphasized that discourse analysis could be influenced by the social nature of learning. He claimed that cognitive development is essentially socially mediated. Children learn and develop cognitive capabilities through social interactions with more knowledgeable individuals [14]. Moreover, Vygotsky [14] proposed the concept of a Zone of Proximal Development (ZPD). ZPD describes the developmental continuum between what children can do on their own and what they can do after receiving help from others [14], which is the core concept of sociocultural theory.

Discourse analysis assists in observing and analyzing interactions inside the ZPD, giving empirical evidence for how learning happens through social interaction. Researchers may examine classroom conversations and interactions to discover how scaffolding and guided participation work in real time. Vygotsky [14] highlighted language as a tool for cognition, while discourse analysis is a tool for investigating how language helps cognitive functions. Besides, AI tools, driven by large databases, can be regarded as "more knowledgeable individuals" to guide students to explore the undiscovered zones and maximize their potential.

Furthermore, as children are just at the learning stage of their language, they are overcoming the limitations of their incomplete grammatical system and logical awareness. Children's discourse can be viewed as a valid part of socialization theory [15]. Children's discourse analysis can start with children's language in meaningful contexts [16][17] and move to the implications of language for self-relevance [15].

To sum up, discourse analysis can expand Vygotsky's sociocultural theory by offering facts and deep insights into the dynamics of social interaction and language use. AI-driven tools can serve as "more knowledgeable individuals" to help students learn better. The combination of AI and discourse analysis is a useful tool to assist educators and researchers in better understanding students' language acquisition and learning process and improving teaching pedagogy based on feedback.

3. Historical View of AI in Language Teaching and Learning

In this section, I list the milestones of AI in language teaching and learning and review the research on the implication of AI in language teaching and learning based on a historical perspective, including the effectiveness of AI in language learning for bilingual learners and considerations of using AI in language teaching and learning.

The implication of AI in education has been a field of scientific research for more than 30 years [18]. The implementation of AI has greatly changed the teaching and learning methods and pedagogy. Teachers use AI in content delivery, virtual reality, and other online instructional media, such as MOOCs [4], as well as adaptive learning activities, assessment, and feedback in adaptive and personalized ways for students [19]. Teachers also use AI in learning analysis [3]. AI tools help teachers reply to students timely [20] and gain a deep understanding of how students optimally learn and how such learning is influenced by prior knowledge, ways of teaching, and learning and physical contexts [19].

Because of AI's outstanding functions, such as personalized teaching content and immediate human-like response, more educators and researchers have noticed the potential of using AI in language teaching and learning. Many studies have been conducted to understand better how AI can improve language teaching and provide a more interactive and immersive learning environment for language learners.

3.1. Evolution of AI in Language Teaching and Learning

The journey began in the 1960s and 1970s with the development of early computer-assisted language learning (CALL) programs, which were primitive and focused on grammar drills and vocabulary exercises with little interaction and customization [21]. Intelligent tutoring systems (ITS) arose in the 1980s and 1990s, taking advantage of artificial intelligence to create more personalized and adaptable learning experiences. These computers might evaluate students' responses and adapt future lectures to their specific needs [22]. The 2000s witnessed significant developments in natural language processing (NLP) and machine learning (ML), allowing AI systems to better understand, analyze, and generate human language. This resulted in the creation of increasingly complex software for language learning to engage learners in meaningful environment. Besides, NLP and ML play important roles in enhancing language understanding and personalizing students' learning experiences [23]. Many researchers focused on the effectiveness of NLP and analyzed the potential of NLP to provide instant feedback for language learners [22]. In recent years, AI becomes a key word in many studies, showing the growing interest and potential of AI tools and technologies in

language teaching and learning [22][24][25]. Conversational AI and chatbots, such as ChatGPT, provide interactive and immersive language learning experiences by engaging learners in natural conversations, providing real-time feedback, and assisting with discourse analysis, making language learning more engaging and effective [26][27][28].

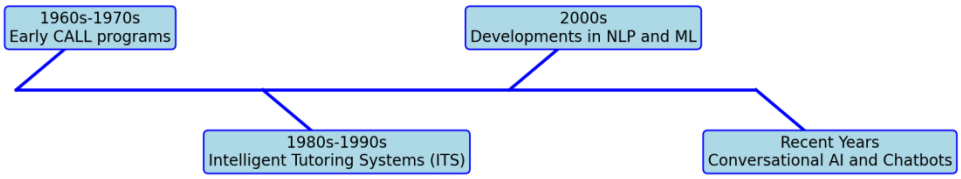

Figure 1. Evolution of AI in Language Teaching and Learning

3.2. Implication of AI in Language Teaching and Learning

Many researchers conduct a bibliometric analysis to have a comprehensive overview of AI in language teaching and learning. Most of them focus on the time period from 20 century to recent years.. Other researchers emphasize the effect of using AI in a specific learning context through case studies. According to previous and recent research, the implementation of AI in language learning has two sides. While AI has various benefits, such as individualized learning, instant feedback, and higher engagement, it also introduces a number of challenges that must be properly addressed.

3.2.1. Effectiveness of AI in Language Learning for Language Learners

AI serves as an effective tool for language teaching and learning since it can improve learners' language abilities [22][26-32]. AI-based tools provide a variety of language activities, including conversation practice, grammatical lessons, and vocabulary-building tasks for language learners to apply what they learned to practice [33]. Moreover, AI-based tools have potential to increase language learners' skills by offering personalized and interactive learning experiences [22][31]. Kim et al. [27] found through a comparative study that AI chatbots, mainly Replika, Andy, and Google Assistant, can significantly improve students' English communication capacity in read-aloud and answering questions because AI chatbots give students opportunities to practice their second language in a meaningful context. Besides, chatbots' model of correcting students' pronunciation can enhance their speaking output and raise their confidence. Jia et al. [29] indicated through mixed-method research that the AIELL system, a web-based English learning platform with AI assistants, can be valid and useful for second language learners' vocabulary and grammar learning in authentic contexts because it can correct spelling and grammar and provide instant feedback based on students' input. Through a comparative study, Qiao and Zhao [30] indicated that Duolingo, an AI-based language learning application, can improve students' second language (L2) language abilities in fluency, vocabulary, accuracy, and pronunciation. It offers students immersive exercises to practice their L2, and personalized instruction provides them with adaptive performance analysis and practice materials, enabling them to improve their language individually. Besides, they demonstrated that AI-based instruction can enhance self-regulation in language learners by encouraging autonomy and metacognitive methods in the speaking domain. Xiao and Zhi [32] revealed that AI-powered tools, mainly ChatGPT, have the potential to improve students' language skills by providing personalized assistance, instant feedback, and critical judgment, which reaches a similar conclusion to previous researchers. They also mentioned that ChatGPT can create an immersive environment by providing realistic conversations for learners to practice their language, which is beneficial for language learners to improve their conversational fluency. Fathi et al. [26] conduced mixed-method research. They concluded that an AI-mediated interactive tool called Andy English Chatbot is more successful in enhancing the bilingual abilities and vocabulary of English as Foreign Language (EFL) learners, compared with face-to-face peer interaction speaking activities, because it provides meaningful exercises for students to practice their language in a low-pressure learning environment. Students can learn language outside their classroom, allowing them to learn wherever they like. Lee and Lim [28] designed an interactive agent called Bert for ELL. They found that conversational teachable agents could support learners with different levels of language proficiency by providing personalized practice materials. Besides, the interactive chatbot can correct students' grammar and pronunciation by giving instant feedback.

AI-based language learning can motivate students to engage and raise students' learning interests [26-29]. Learners are more willing to interact with AI tools than traditional face-to-face training because it reduces second language learners' anxiety about practicing language in a public environment [34]. Fathi et al. [26] further emphasized students' good attitudes and enjoyment of using AI-based language learning tools because the learners reported that the AI-mediated teaching enable them to practice their second language without being judged or biased due to their mistakes or accent, which raised their confidence in using both languages. Their studies align with Kim et al.'s [27] result. Kim et al. [27] demonstrated that with the use of AI tools, mainly Replika, Andy, and Google Assistant, students showed more interest in language learning because it provides students with a

more comfortable and less stressful learning environment, which makes students feel relaxed and excited. Jia et al. [29] mentioned that AI-based teaching motivates students because it gives students autonomy in learning in a contextual environment. Individualized learning interaction engage students to participate in tasks and activities [35].

To sum up, the implementation of AI in language learning can improve student's bilingual skills in an effective method because AI can provide a meaningful, immersive, and interactive learning environment for learners to practice their language, and instant feedback and assessment can help students improve their grammar, pronunciation and other bilingual skills. Moreover, using AI in teaching can motivate students to engage in learning activities and show more interest in language learning because students can have autonomy and personalized learning experience and obtain confidence in using bi-languages in a low-stress and joyful environment.

3.2.2. Considerations in AI-based Language Learning

Although AI has many benefits in language teaching and learning, the application of AI in educational contexts raises a number of considerations such as challenges and risks related to ethics, privacy, fairness, diversity and inclusion [19][36-38], and the potential knowledge and skills gaps that educators may need to fill in order to improve teaching and learning with AI-based education [18, 19].

Lameras and Arnab [19] raised questions about the ethical issues that AI may cause. They worried that AI-based system may be biased toward student capabilities and performance as well as students' diverse backgrounds since the output of AI is based on programmatic databases. They also mentioned about the challenge of keeping students' privacy, such as how the data will be used and where the information will be stored. They pointed out the necessity for developers, designers, and educators to act ethically to reduce the risk of ethical issues. Mhlanga [36] also cares about the privacy and bias issues of AI in education. He emphasized that keeping students' personal data safe is essential and that students need to be informed before AI is used in the teaching process. This aligns with Qadir's [37] research results that protecting students' private information is a must-to-do task. Besides, he worried about bias that may exist in AI-provided text if AI is not trained properly, which may result in serious mental issue for students. Rudolph et al. [38] pointed about the issue of fairness of using AI in education because students can use AI-based tools to quickly create high-quality materials, making it difficult to identify plagiarism and leading to unfairness.

To effectively utilize AI in classroom settings, teachers, AI designers, law makers and other people in related fields need to work together to face the challenges and risks that AI may cause in education. Luckin and Holmes [18] indicated that to use AI properly in the school setting, teachers are required to develop their digital skills, and extra training may be needed. AI designers need to consider inclusiveness and diversity when designing AI tools, especially with educational functions. Lameras and Arnab [19] found that teachers may feel overwhelmed when using different types of AI tools during teaching, so they came up with a similar suggestion as Luckin and Holmes [18] that schools should provide digital practice and extra support for teachers when implementing AI in teaching. Mhlanga [36] believes AI is not a substitute for human teachers. Teachers need to use AI-based tools properly and remember that education should not only offer information but also foster human interactions. Educators and AI designers need to put students' safety first. Besides, teachers can educate students the advantages and limitations of AI so they can think critically towards AI. Moreover, lawmakers enact laws and regulations to regulate AI tools in education to provide students with a safe learning context.

Therefore, many challenges and risks such as ethical issue, privacy, bias, plagiarism, diversity, and inclusion that teachers need to consider when using AI in teaching. Moreover, teachers may need extra training and a systemic guide to develop their teaching skills before implementing AI in their pedagogy. AI designer and law makers need to work together with teachers to create a safe and respectful learning environment for students so they can learn with joy regardless of bias and unfairness.

In conclusion, recent studies analyzed that implementing AI in language learning can be effective and useful for language learners. It can provide students with a meaningful and interactive learning context and personalized learning content and motivate them to learn language confidently in a low-stress environment. Meanwhile, teachers need to consider the challenges and risks that may caused by AI, and extra training and support are needed for teachers. However, most recent research only focuses on university settings or upper-grade students. There is a gap in viewing young children as the users of AI in the school setting. Therefore, this study focuses on early childhood classrooms, aiming to explore the potential and challenges of AI in bilingual teaching for young children and providing an exploratory review for further studies.

4. Effects of AI Tools on Discourse Analysis in Early Childhood Bilingual Education

In this section, I first introduce the research method used in this paper and the results of the study. The discussion part explains the effects of AI tools on discourse analysis in early childhood bilingual education, and the considerations and challenges of AI tools in education revealed from this study, linking to previous literature

4.1. Method

Drawing on previous research on discourse analysis and AI-based language teaching and learning, I conducted a one-hour in-depth online interview with an educator who teaches elementary-level Chinese-English bilingual students in Arizona to learn his real feelings and challenges of implementing AI tools in his pedagogy and his understanding of using AI to analyze discourse in assessing students' bilingual skills and language proficiency.

The educator manages a five-grade bilingual classroom with 30 students. He offers all subjects in Chinese and English. This year is his second year as a bilingual full-time teacher in Arizona. Before this interview, he had rich experience and practical training on AI tools in bilingual education offered by his school district. Therefore, his teaching experience can be used as an appropriate example to study the effects of AI tools on bilingual young children. During this interview, ten questions were asked about his experience of using AI tools in bilingual education, such as AI tools that he used, the ways he used AI tools, especially in discourse analysis, students' feedback and academic performance, and his considerations and challenges of using AI tools in bilingual education.

The whole interview was audio recorded with the participant's agreement. The recording of this interview is coded by Xunfei, a speech recognition technology, into a text-based transcript for analysis. The first author checked and reviewed the transcript for accuracy.

4.2. Results

Thematic analysis of the semi-structured interview reveals many themes reflecting the educator's positive attitude and perception about incorporating AI tools in bilingual classrooms. It explains the research questions of the effect of AI tools on young children's development of bilingual skills and how discourse analysis of AI tools assists teachers with their bilingual teaching.

4.2.1. Importance of Practical Training on AI Tools for Educators

First, the participant acknowledged the use of AI tools in daily teaching. ChatGPT, Gemini, Magic School, and Canva are some platforms used to organize and develop educational programs. He also noted that their school district provides regular AI and educational technology training to keep teachers up to date on the newest technology-involved teaching methods.

> *"We use AI extensively in our lesson planning and the design of educational activities. Our school district also provides regular training on AI and educational technology to ensure that teachers are up-to-date with the latest AI advancements and can apply them effectively to enhance students' learning experiences and outcomes."*

The participant shared how he incorporated AI tools in his teaching and showed a positive attitude toward AI-driven pedagogy. He used ChatGPT to generate a story starter and then encouraged students to continue writing the rest of the narration, which enhanced student' creativity and critical thinking. He utilized Gemini to analyze students' responses to a reading comprehension task. The detailed feedback helped students comprehend their mistakes and grow from them. He incorporated Magic School to create playful and interactive gamified activities to encourage students to participate and learn in an enjoyable environment. He implemented Canva to create visual infographics and posters to support visual learners in better understanding the course content through an accessible and engaging method.

> *"We incorporate AI in designing educational activities, creating Higher Order Questions, and more. For example, we use ChatGPT to generate engaging writing prompts for our students, which encourages creativity and critical thinking. Gemini is another AI tool we use to analyze student responses. It helps in generating targeted feedback that aligns with specific learning objectives. Magic School is employed to design interactive and gamified activities that make learning fun. Canva is also used for creating visually appealing materials, such as infographics and posters, which support visual learners."*

4.2.2. Effectiveness of AI Tools in Bilingual Teaching, Especially on Discourse Analysis

He emphasized the effectiveness of utilizing AI tools in bilingual teaching. In Chinese-English bilingual courses, he used AI to generate activities, practice videos, and games, creating an immersive learning environment for his students. He highlighted the benefits of AI tools in improving students' speaking abilities since they allow them to interact with peers and educators while practicing their language. Furthermore, he noted students' positive feedback toward the AI-involved curriculum, stating that they were more willing to explore and absorb new facts, which motivated them to participate in course activities.

> *"In our language classes, we use AI to help design activities and games. Students also have the opportunity to engage with AI platforms. AI-generated practice videos, for example, can be particularly helpful for improving students' speaking skills. Students are often more eager than teachers to explore and learn about AI. Cutting-edge technologies like AI hold significant appeal for them."*

Regarding discourse analysis, he highlighted the effectiveness and efficiency of using AI tools for discourse analysis. He mentioned his experience using ChatGPT in his Chinese-English immersive bilingual courses. Once, in a reading class, he

incorporated ChatGPT to analyze the depth of students' responses to the story themes. The detailed feedback provided by ChatGPT enabled him to deeply understand students' learning processes and how he can support students in expressing complex ideas appropriately in both Chinese and English. He also shared his another teaching example of using AI tools in his writing lessons. He stated that the suggestions generated by AI tools help students structure sentences more effectively in both languages, enhancing students' bilingual acquisition and developing students' critical thinking skills through meaningful and immersive class conversations.

> *"We have used AI tools for discourse analysis, and they have proven to be very effective and efficient, often providing unexpected insights. Specifically, we use ChatGPT for analyzing student discussions in both English or Chinese. Regarding the impact of AI on students' bilingual learning, we've noticed that tools like ChatGPT have enhanced students' ability to express themselves in both languages...Based on what I have observed so far, the use of AI in discourse analysis has not only improved students' language proficiency but also their critical thinking and ability to engage in meaningful conversations, which are crucial skills in bilingual education."*

4.2.3. Consideration and Challenges of Using AI Tools in Education

The participant concluded that AI is effective and beneficial for bilingual education because of its powerful functions of providing instant feedback and personalized learning content, but it must be used wisely. Students may reply on AI tools and refused to do their tasks by themselves. Besides, AI tools may bring privacy risks for students, so teachers need to keep vigilant and cautious when implementing AI tools in teaching and learning.

> *"I believe AI is a powerful tool that can greatly benefit education, but it must be used wisely. Some students may rely on AI to complete tasks or even to avoid doing their work, which is inappropriate. We guide our students in this regard. Additionally, AI poses potential privacy risks, so it's important to remain vigilant."*

Overall, the themes revealed from the semi-structured interview of this qualitative study suggest that incorporating AI tools into bilingual education is effective and meaningful. It can provide teachers with timely analysis of students' learning progress and generate playful and interactive course activities to motivate students to participate and be engaged into courses. Personalized course content and instant feedback can support students to develop their language skills through an immersive and interactive learning method and help them improve their language through multiple practice activities. However, how to use AI tools properly in teaching and learning is still a consideration and challenge for educators because of the potential for privacy risks and developing students' unwillingness to self-thinking.

4.3. Discussion

Drawing on Lev Vygotsky's [14] sociocultural theory, this study investigated the effect of AI tools in bilingual education with an emphasis on discourse analysis, in early childhood classroom. The findings of this study revealed the potential of AI tools in bilingual education, especially the effectiveness of AI tools on discourse analysis, and the challenges and considerations that educators need to be aware of when implementing AI tools in educational settings.

The first finding of this study is that the incorporation of AI tools in bilingual education has a positive impact on the development of young children's bilingual skills, which aligns with the findings of Fathi et al. [26], Jia et al. [29], Kim et al. [27], Lee and Lim [28], and Qiao and Zhao [30]. AI tools can provide multiple interactive and immersive activities for language learners to practice their language in a meaningful educational setting [22, 31]. Especially, such language practice can improve students' speaking skill. Besides, AI tools can support students and educators with instant feedback and personalized course content [29, 32] maximizing the flexibility and effectiveness of bilingual education. Moreover, with AI-driven courses, students are more eager and willing to participate in course activities and show their motivation in bilingual learning, which is consistent with the finding of Fathi et al. [26], Guo et al. [35], and Lee and Lim [28]. AI tools appeal to young children, encouraging them to explore their learning through playful and enjoyable methods. Based on Lev Vygotsky's [14] sociocultural theory, AI tools do serve as "more knowledgeable individuals" for students to expand their ZPD and motivate them to maximize their potential.

Moreover, this study highlights the effectiveness of AI tools on discourse analysis. AI tools such as ChatGPT can provide timely feedback about students' discourse and analyze their language acquisition progress for educators to modify their pedagogy and support students with specific needs so students can have a better understanding and acquisition of their bi-languages and gain confidence in using both languages in their academic and daily conversations.

Furthermore, this study has similar findings on the considerations and challenges of implementing AI tools in education with Lameras and Arnab [19] and Qadir [37]. When using AI tools in daily pedagogy, educators need to be aware of the privacy risks that may occur by AI tools. Or students' personal information may be leaked or used in improper places. Another consideration of the educator's skill gap in using AI tools in teaching does not happen in this study since the participant has been receiving regular training about how to properly use AI tools in education. However, paying attention to this issue is still essential because it may happen in other school districts where teachers have not received any training on using AI tools.

5. Conclusion

This qualitative study provides first-hand data and proves the positive impacts of AI tools in bilingual education for young children and the effectiveness of AI tools on discourse analysis. Moreover, the study reveals the considerations and challenges that educators may face when implementing AI tools in education, providing a broader perspective to better understand how to utilize AI properly in language teaching and learning.

5.1. Practical Implications for Bilingual Teaching and Learning

The findings of this study have practical implications for educators, researchers, policymakers, and bilingual learners. First, this study indicates that the implementation of AI tools in bilingual education can provide immersive and interactive course content for language learners to participate actively in course activities and have multiple opportunities to practice their languages. Besides, timely feedback and accurate discourse analysis can help educators improve their bilingual teaching and offer students with more targeted language scaffolding and support. At the same time, students can raise their learning interests and be more confident in using languages in a playful and engaging environment. Moreover, this study provides meaningful data and information for researchers to study using AI tools in early childhood educational settings, filling the gap that most previous research focused on upper- or university-level students. It provides the possibility and potential of using AI tools for young children to improve their bilingual skills. Furthermore, this study proves that AI tools can effectively analyze discourse, which can inform educators and researchers of using AI tools such as ChatGPT to analyze students' discourse and improve bilingual teaching and learning processes. The considerations and challenges mentioned in this study can raise the awareness of educators, researchers, and policymakers of the risks that AI tools may bring to education. How to protect students' personal information and help students gain progress from AI through a safe method are still issues that need to be discussed. Last but not least, this study proves that practical training for educators on the implementation of AI tools is necessary because it can provide educators with in-time information on what AI tools they can use and how they can implement AI in their pedagogy so they can improve their teaching in a balanced and effective method.

5.2. Limitations and Suggestions for Further Research

This study has limitations that need further research. First, this study is a case study, so it may be unique, not representing other cases of implementing AI tools in bilingual education. Therefore, further research can include a large sample size, and comparative studies can be conducted to provide more data to analyze the effect of AI tools in bilingual education and the potential of AI tools on discourse analysis.

Besides, this study is short-term research. Further long-term studies can be conducted to collect broader data and analyze how AI tools can affect long-term bilingual education.

Furthermore, other AI tools expect the tools mentioned in this study can be further studied on their effects and potential on discourse analysis to have a broader understanding of AI tools in education, especially in bilingual education.

Overall, because of the effectiveness of discourse analysis of AI tools in early bilingual education, it is worth studying the potential of AI tools, to help bilingual students learn in a meaningful and joyful environment in the technology-rich era.

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