

Bilingual Thinking: An Analysis of The Effects of Bilingual Education on Children's Cognitive Development

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Abstract:

The impact of bilingual education on children has gained increasing attention due to the development of society, economy, and international exchange. Numerous studies on this topic have emerged domestically and internationally since the beginning of the century. Our group aims to summarize the impact of bilingual education on children's cognitive abilities through a literature review. We will consider children's language ability, memory and attention development, social skills, and critical thinking. We will then summarize and discuss the factors, processes, and reasons influencing bilingual education. Based on the literature reviewed, this text discusses the limitations of bilingual education about cultural differences, teacher training, and educational resources. Additionally, it envisions the prospects for the development of bilingual education through research on teaching models and the development of educational resources.

Keywords: bilingual education; bilingual teaching; language ability; cognitive ability.

1. Introduction

Bilingual education is a significant focus of academic research and an ongoing field of exploration and advancement in educational practice due to globalization and multiculturalism. Bilingualism is increasingly recognized as a crucial social and personal growth skill due to the expanding global cultural interactions. Bilingual instruction in early education has garnered significant attention from educational scholars and practitioners due to its influence on children's cognitive development.

Bilingual teaching has been in use and under study since the early 20th century. Advancements in science and technology and the increasing pace of globalization have led to substantial changes in both the structure and substance of bilingual education. These changes have impacted the selection and application of educational methods and have significantly influenced children's cognitive development. Bilingualism is especially beneficial for language ability, memory, attention, social skills, and critical thinking.

Bilingualism has been demonstrated to improve early children's awareness and proficiency in language skills. Early exposure to and study of a second language in education enhances children's proficiency in their native language and helps them develop a fundamental grasp

and application of the second language from a young age. Nikolov, M., & Djigunović, J. M. (2006) Early exposure and acquisition of a language are crucial for the enduring development of a child's linguistic abilities [1].

Bilingualism offers distinct benefits for memory and attention development. Studies have shown that multilingual individuals excel at control tasks due to the heightened attention and memory management needed to handle information in several languages. This enhanced capability extends beyond language acquisition to encompass cognitive domains like mathematics and science education.

Bilingualism also enhances social skills and critical thinking abilities. Learning a second language helps youngsters comprehend and embrace diverse cultures and viewpoints, which is crucial for enhancing their social skills and critical thinking abilities. Bilingualism facilitates language acquisition and fosters cultural exchange, enabling youngsters to develop a global perspective.

Challenges remain in current educational research regarding the proper implementation of bilingualism and the assessment of its unique impact on young children's cognitive development despite its many advantages. This study conducts a systematic review and analysis of the current literature to thoroughly investigate how bilingualism affects cognitive development in young children. It focuses

on language proficiency, memory, attention, social skills, and critical thinking. This study aims to investigate the impact of bilingualism on young children by reviewing literature from databases like Knowledge.com, Taylor & Francis Online and Google Scholar. This study evaluates the effects on various cognitive and social areas and suggests effective bilingualism strategies and recommendations.

The current research aims to enhance the theoretical basis in bilingualism and offer practical guidance for educators, policymakers, and parents to support the development of young children through bilingualism. This study aims to offer valuable insights and implications for future educational practices and research by conducting thorough analyses and debates. The goal is to effectively harness the benefits of bilingualism and establish a strong basis for children's cognitive and social development.

The introductory section of this study aims to give readers a thorough overview by explaining the background, importance, and purpose of bilingualism. It also clarifies the focus and expected outcomes of the study, setting the groundwork for the upcoming research content and discussion.

2. Analysis

2.1 Definition of Bilingual Education

Bilingual education uses a second or foreign language in schools to teach intellectual subjects. This definition aligns with the Longman Dictionary of Language Teaching & Applied Linguistics. The Encyclopedia of Bilingualism and Bilingual Education defines bilingual education as using two languages in school, where subjects such as science, mathematics, social studies, or humanities are taught in both languages.

Bilingual education can be broadly categorized into two types: bilingual education that uses two languages in schools (e.g., English language teaching is prevalent in our country) and bilingual education that teaches subject matter in a second or foreign language [2].

Bilingual education can be roughly divided into two types: ABE adds a second language to a student's existing language skills, while SBE replaces the student's primary language with the second language. It is important to note the distinction between these two types of bilingual education. Additive Bilingual Education (ABE) and Subtractive Bilingual Education (SBE). The term 'bilingual education' refers to using a second or foreign language as the medium of instruction to train students to master two languages without replacing their mother tongue. Canada is an example of a bilingual country that aims to train students to become proficient in both English and French.

The latter employs a second or foreign language as the language of instruction, to replace the students' mother tongue or first language. An example is the bilingual education program adopted by the United States for immigrant students, through which they gradually transition to using English. The process of English-Chinese bilingual education in China is characterized by additive bilingual education. In English-Chinese bilingual education, Chinese schools often offer separate courses in English and Chinese. English education does not affect students' mastery of Chinese, which is often their mother tongue. This 'bilingual education' aims to train students to be bilingual. This 'bilingual education' aims to train students to be bilingual in Chinese and English to meet the needs of society. This article focuses on additive bilingual education under the narrow definition.

2.2 Impact of Bilingual Education on Children's Language Skills

The impact of bilingualism on children's language skills is a highly controversial issue. In the first half of the twentieth century, in countries where English was the first language, a popular view emerged that starting bilingual education in early childhood would lead to confusion and detrimental to language learning.

However, a study conducted by Peel and Lambert in the late twentieth century on the impact of bilingualism on children's abilities suggests that the commonly held view may not be entirely accurate. The study, which lasted approximately one week and administered tests of verbal and nonverbal ability to children around the age of ten in six French-speaking schools under the jurisdiction of the Montreal Council of Catholic Schools, showed that bilinguals outperformed monolinguals on both tests. Several explanations have been proposed for the generalized intellectual superiority observed in bilingual individuals. One suggestion is that their bilingualism provides them with more linguistic resources, making it easier for them to form linguistic concepts and exhibit greater mental flexibility. The results of a factor analysis of the data support the hypothesis that the two groups have different intellectual structures. Bilingual individuals appear to possess more diverse mental abilities than monolingual individuals [3].

Research on the cognitive effects of bilingualism has continued to grow in the 21st century. Previous studies have shown that monolinguals perform better than bilinguals on language, memory, attention, and processing speed tasks. However, when it comes to executive functioning abilities, the opposite is true for bilinguals. Monolinguals did not show significant differences in language use and executive functioning compared to young bilinguals. In

a recent experiment, researchers examined the cognitive abilities, including memory, of young monolinguals and young bilinguals learning English as their first or second language. The results showed that the monolingual group outperformed the bilingual group in cognitive aspects such as memory, language, attention, and processing tasks. However, no differences were found in performing functional tasks [4].

Language acquisition is a gradual process that follows a non-linear trajectory, similar to acquiring knowledge. Bilingual children may experience a slight delay in the development of their acquired language compared to monolingual peers. Still, this delay gradually disappears with increased exposure to the language they are learning [5].

On the other hand, studies have shown that bilingual children, despite their vocabulary limitations, are not less competitive in their second language than monolingual children. It is important to note that their bilingual vocabulary may be less extensive than that of monolingual children. On the other hand, studies have shown that bilingual children, despite their vocabulary limitations, are not less competitive in their second language than monolingual children. Research has shown that bilinguals generally perform better in learning additional languages than monolinguals. This is often attributed to bilingual learners' meta-linguistic competence, which refers to their ability to understand language structures [6].

In 2003, three studies were conducted on bilingual and monolingual children from kindergarten to second grade to examine the development of phonological awareness [7]. In one study, monolingual and bilingual children performed equally well on complex tasks requiring phoneme substitutions. Another study produced similar results, and a third study expanded the research to include two groups of bilingual children and a variety of phonological awareness and reading tasks. Throughout the study, Spanish-English bilinguals outperformed English monolinguals on a phoneme segmentation task, while Chinese-English bilinguals performed worse. There were no differences in other measures of phonological awareness among the three groups. The findings are discussed in terms of the limitations of the effects of bilingualism on metalinguistic development.

Verbal fluency tests are commonly used in neuropsychological assessments to evaluate word retrieval abilities in speakers. These tests require word meaning memory and executive control and include category tests (e.g., naming several vegetables) and letter tests (e.g., naming words beginning with the letter B). Studies on verbal fluency have found no significant difference in performance between bilinguals and monolinguals regarding verbal communication fluency. Bilingual individuals often switch

between their mastered languages. However, the broader attentional control involved in language switching, such as task-switching, lacks sufficient evidence or has mixed results in current experiments. Monolingual and bilingual young participants were asked to switch non-verbal information in one experiment. During the experiment, participants viewed colorful pictures of animals and were instructed to name the animal or its color [8]. Both monolinguals and bilinguals performed similarly in this type of message switching, which involved unidirectional switching from nonverbal to verbal messages. However, bilinguals exhibited faster reaction times than monolinguals, indicating a better ability to associate messages with responses. The study indicates that practicing multiple languages regularly can result in wider executive functioning benefits, such as increased flexibility in language switching [9].

2.3 Impact of bilingual education on children's memory and attention development

Research on bilingual education's impact on children's cognitive functions, specifically working memory, short-term memory, and attentional control, shows that these educational settings significantly enhance children's language skills and cognitive capabilities. Ozfidan (2021) highlights a key distinction between working memory and short-term memory: working memory is involved in manipulating and processing information, whereas short-term memory primarily focuses on the temporary storage of information [10]. The difference provides a crucial theoretical structure for comprehending studies on how bilingualism impacts children's cognitive skills.

Existing studies demonstrate intricate and multifaceted paths of influence on memory ability. Barac et al. (2014) found no significant difference in the performance of monolingual and bilingual children on a basic test measuring numerical breadth. This indicates that the bilingual environment did not directly impact children's memory capacity in specific memory tasks [11]. Lanfranchi and Swanson (2005) propose a contrasting perspective by demonstrating that bilingual children's short-term memory capacity is linked to their language abilities, indicating language dependency. Specifically, children perform better in short-term memory tasks in languages with richer vocabularies. Working memory capacity is language-independent and remains unaffected by an individual's language skills [11].

A study conducted by Morales et al. (2013) supports the benefits of working memory in bilingual children, particularly in tasks with added executive function demands. The results emphasize the cognitive benefits children in bilingual settings have when dealing with complex materials

and tasks [12].

The distinct mental challenges in a multilingual learning setting benefit children's cognitive regulation and focus. Barac et al. (2014) discovered that four-year-old bilingual children who spoke Korean and English performed better than monolingual children on tests related to executive function. This benefit may result from the frequent language switching necessary in a multilingual setting, which boosts children's cognitive flexibility and attentional control [11]. This aligns with Bialystok's (2001) theory, proposing that cognitive development involves the creation of more organized knowledge structures and increased regulation of attentional mechanisms [13].

Yang & Yang (2016) conducted an experiment that found positive impacts of bilingualism on attentional control, especially in cognitive functioning when facing distractions and conflicts. The effects were more significant in children than adults in a controlled study involving both age groups [14]. Early bilingual experiences are indicated to have lasting beneficial impacts on improving attentional control.

According to a recent study, Fatima & Atta (2024) conducted a study on how a multilingual environment affects students' cognitive processes and language development in public schools in Sialkot, Pakistan. The study underscored the significance of bilingual or multilingual in improving memory, attention, and problem-solving abilities. It emphasized the beneficial impact of multilingual settings on strengthening kids' cognitive and linguistic development [15].

Besides improving cognitive skills, using several languages in multilingual settings can stimulate children's creative thinking. Through continuous language switching, youngsters develop the ability to think from many viewpoints and utilize numerous languages to communicate thoughts. This diverse thinking process is essential for fostering innovation and addressing problems. Bilingual learning can enhance cognitive inhibition and flexibility, promoting the development of various components of creativity. The results prove the connection and processes linking bilingual learning and creativity [16].

Bilingualism has intricate and numerous impacts on early memory and attention development in young infants. Research has demonstrated that bilingual environments positively impact young children's cognitive abilities, particularly in memory capacity and attentional control. The findings offer a strong scientific foundation for bilingual education and a significant direction for future research and educational practices. By conducting thorough research and comprehending the various impacts of bilingual education, we can enhance our ability to create and execute educational approaches that foster the comprehen-

sive growth of children.

2.4 The impact of bilingual education on children's social skills and critical thinking.

The impact of bilingual education on children's social skills and critical thinking is evident in studies exploring this area, with significant improvements observed in students' collaboration, social abilities, and the formation of critical thinking within this educational environment.

First, based on the literature „The Application of Cooperative Learning Method in Large Class Bilingual Teaching Context“ by Wang Xiaohua [17], we conducted a study on the influence of students' social skills in the context of bilingual teaching. This study is based on the principles of the Cooperative Learning Approach, which originated in the United States in the 1970s and has been widely recognized in the Western education community for nearly 40 years. It has also been widely used in school teaching. Cooperative learning is a teaching method that advocates for teachers and students, as well as among students, to work together to achieve a common goal and create an environment for collective learning, thereby achieving the learning objectives of the learners. Through the five components of positive Interdependence, Promotive Interaction, Individual Accountability, Social Skills, and Group Processing, in bilingual education, this approach completely differs from competitive learning and learning methods aimed solely at achieving a certain goal. Its student-centered and needs-oriented core emphasizes the teacher's role in assisting, facilitating, and supporting student learning processes. The study results show that using cooperative learning in a bilingual context has motivated students' learning enthusiasm, enhanced their awareness of sharing learning outcomes, and, more importantly, cultivated students' collaboration abilities. At the same time, collaborative learning also enables students to understand themselves and others correctly. From this, we can conclude that bilingual education positively impacts students' social and collaborative skills.

At the same time, bilingual education also impacts the cultivation of critical thinking in children's education. Some studies have shown that bilingual education can promote students' critical thinking ability. By learning a second language, students need to deal with differences between multiple languages and cultures, thereby cultivating their comparative and analytical abilities. In addition, bilingual education can help students overcome language and cultural barriers, better understand different viewpoints and thinking styles, and promote the development of critical thinking[18]. In this literature, students in the elementary school stage are not yet fully mature in their physical and mental development, and their thinking is in

a golden development period. Therefore, when carrying out English teaching activities in elementary schools, teachers must design teaching activities around developing students' critical thinking, which is conducive to creating an efficient English teaching classroom, solving the current problems in elementary school English teaching, and developing students' critical thinking. Therefore, it can be seen that bilingual education positively impacts the cultivation of critical thinking.

3. Conclusion

Based on the above analysis, we have concluded that bilingual education positively impacts children's language abilities, cognitive abilities, social skills, and critical thinking. Firstly, bilingual education helps improve children's language abilities. Learning two languages can enhance children's vocabulary, grammar knowledge, and language expression, making them more flexible and diverse in language. Secondly, bilingual education promotes children's cognitive abilities. Learning a second language can improve children's attention, memory, problem-solving abilities, and flexibility, promoting cognitive development. In addition, bilingual education also has a positive impact on children's social skills. Children can better understand people from different cultural backgrounds by learning different languages, promoting cross-cultural communication and understanding, and enhancing social skills and cultural adaptation. Finally, bilingual education also helps cultivate children's critical thinking. Learning two languages can enable children to think more flexibly about problems and more openly accept different viewpoints and cultures, cultivating critical thinking and analytical abilities. Overall, bilingual education positively impacts children's language abilities, cognitive abilities, social skills, and critical thinking, benefiting them in multiple aspects.

Research on bilingual education may support certain theories or propose new theoretical viewpoints. It may also offer guidance for practical applications or help solve real-world problems. Bilingual education research faces some limitations in practice and many potential future directions.

Firstly, in terms of limitations, there are cultural differences, the need for more cross-cultural comparative research, the requirement for well-trained bilingual teachers, and the lack of teaching resources that currently restrict the development of bilingual education.

As for future development directions, further research on different bilingual teaching modes, strengthening the training of bilingual teachers, and investing more resources in developing the necessary teaching materials and resources

for bilingual education are essential. Moreover, future bilingual education research should focus more on practical applications, promote the practical effects and teaching quality of bilingual education, and strengthen theoretical exploration and innovation.

This study presents a literature review on the impact of bilingual education on the cognitive development of young children, demonstrating the importance and value of bilingual education in the multicultural and globalized era. The research indicates that bilingual education has significant advantages in language learning and has positive effects in promoting children's cognitive development, attention, problem-solving abilities, and critical thinking. Bilingual education displays its unique advantages, particularly in cultivating children's working memory and short-term memory and enhancing concentration.

Furthermore, bilingual education also positively impacts children's social skills, such as enhancing collaborative abilities and critical thinking. These skills are crucial for children's future academic and personal development. However, implementing bilingual education also faces challenges, including cross-cultural teaching differences, the need for professional training for bilingual teachers, and a shortage of bilingual teaching resources.

Despite facing some challenges and limitations, the potential benefits of bilingual education in early childhood education are evident. Therefore, to fully utilize the advantages of bilingual education, future research and educational practices should focus on optimizing teaching methods, enhancing teacher training, and investing more resources in developing bilingual teaching materials and resources. Through these measures, we can better promote the practical effectiveness of bilingual education, improve teaching quality, and provide a solid foundation for the comprehensive development of children.

Authors Contribution

All the authors contributed equally, and their names were listed alphabetically.

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