

The Role of Bilingual Teaching Strategies in Improving the Comprehensive Abilities of Learning Non-language Subject of High School Students

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Abstract. The world has now entered a historical phase in which countries are increasingly interconnected. In order to seek cooperation, cultivating professionals proficient in bilingualism has become a critical component of the contemporary era. Bilingual education focuses on cultivating bilingual experts and contributes to the development of globalization. Through a literature review approach, this study explores the role of bilingual teaching strategies in enhancing high school students' comprehensive competencies in acquiring non-linguistic subjects. This study reveals that bilingual education facilitates the learning of non-linguistic subjects rather than hindering it. Also, bilingual education enhances students' interest in non-linguistic subjects, motivating their active participation and increased engagement in related classes. Last but not least, bilingual education has a positive impact on students' academic results.

Keywords: bilingual teaching, bilingual education, non-language subject learning

1. Introduction

With the establishment of global organization, such as WTO, IMF and WB, globalization has propelled the world into an era of deepened interconnectedness among nations. Different countries need to cooperate with each other in order to advance economic development and pursue shared interests. To seek cooperation, English has emerged as a pivotal bridge for communication across culturally diverse nations. Under this background, cultivating experts who are both good at Chinese and English is the main point for strengthening cross-cultural communication and driving economic growth. Bilingual teaching plays a significant role in cultivating the talents of both languages. China's latest bilingual education policies prioritize English as a medium of instruction for specific subjects to nurture international talents, while concurrently reinforcing Chinese cultural identity. Above all, bilingual teaching has taken a necessary place in modern teaching process.

Bilingual teaching has produced lots of constructive conclusions, and there are some famous theories which make constructive progress. Ellen Bialystok, a prominent scholar in the field, posits that bilingualism enhances the brain's executive functions. This is a cognitive system responsible for regulating attention, inhibiting irrelevant information, and facilitating task switching. Bilinguals individuals continuously regulate two language systems, serving as a form of "mental workout".

Also, Wayne P. Thomas & Virginia P. Collier argue that dual-language immersion/one-way programs (a strong form of bilingualism) yield the most substantial long-term academic achievement in both languages.

The purpose of studying this topic is to conduct an in-depth investigation into approaches to enhancing high school students' comprehensive competencies. These competencies encompass not only English academic performance but also global perspective, interdisciplinary learning capacity, and other related skills. Nowadays, international competition is becoming increasingly fierce and experts with comprehensive skills and knowledge are required. Bilingual teaching is aimed at cultivating comprehensive talents, thereby contributing to globalization and enhancing national competitiveness in the international arena. How to improve students' multi-faceted abilities and cultivate more talents for country is the main idea of this essay.

2. Literature review

Bilingual education serves as a pivotal instrument in modern educational practices. Bilingual refers to the ability to use two or more languages proficiently. One of the language is a native language, while the other is a second language that is not one's native language. To illustrate, an individual proficient in multiple languages can utilize two languages with relative fluency in daily communication, though their mother tongue often remains dominant. The definition of bilingual education is using at least two languages as instructional media for non-linguistic disciplines, including history, mathematics, and other subjects. Languages are the carriers of cultures, and distinct cultural contexts are associated with unique modes of thinking. During the procedure, students can become familiar with both languages and enhance the ways of thinking which are connected with different cultures. In this process, students can develop proficiency in both languages and cultivate cross-cultural thinking capacities. Scholar defines bilingual education as a subject teaching approach that intentionally employs two language systems or adopts a non-native language as the medium of instruction [1]. In essence, bilingual teaching functions as a medium for delivering target content, with the core objective of improving students' understanding of subject knowledge and fostering the development of interdisciplinary thinking.

With the development of bilingual education, bilingualism and cognitive theories have gained increasing significance in the educational domain. The executive function advantage theory, which was proposed by Alan Bialystok and Michelle M. Martin Ray, indicates that bilingual individuals continuously monitor, select, and inhibit two language systems during daily communication [2]. This regular "mental exercise" substantially enhances the brain's executive functions, which encompass higher-order cognitive processes such as attention regulation, cognitive flexibility, working memory, and inhibitory control. Research indicates that bilinguals typically outperform monolinguals in these cognitive domains and may even delay the onset of age-related cognitive decline, such as Alzheimer's disease. To give an illustration, using no less than two languages in daily life can train diverse thinking modes and enhance brain function. In the exercise process, people can improve their brain functions, thereby delaying or mitigating the risk of certain neurological disorders and sustaining cognitive health. This theory offers robust scientific evidence for the advantages of bilingual education from the perspectives of neuroscience and cognitive psychology.

Moreover, language acquisition theories occupy a pivotal position in the development of bilingual education. One of the most vital theories is the input hypothesis proposed by Stephen Krashen, which posits that the sole pathway to language acquisition is exposure to substantial "comprehensible input"—language materials marginally beyond the learner's current proficiency

level ($i+1$) [3]. That implies that the selection of appropriate learning materials is crucial, as excessively challenging content may impede students' comprehension. Optimal materials should be moderately more advanced than students' existing proficiency and knowledge base while remaining within their zone of proximal development. Apart from that, Stephen Krashen also points out that consciously learned language rules can only play a "monitoring" and correcting role, not drive true acquisition. To illustrate, people always facilitate the retention of implicit linguistic knowledge, whereas conscious learning does not yield comparable outcomes. Because of that, providing students with immersive instructional contexts can improve learning efficiency, which constitutes a fundamental basis for bilingual education.

Bilingual education also exerts numerous significant impacts on students' development. Cummins, J. pointed out that bilingual education fosters the development of students' critical thinking and metalinguistic awareness, lays the groundwork for interdisciplinary learning, and is highly consistent with the "critical thinking enhancement" component in instructional design [4]. Bilingual education can offer chances for students to engage with the cultures embedded in non-native languages, thereby enhancing their cross-cultural competence. Simultaneously, it acknowledges the cultural value of students' mother tongue and supports the development of their cultural pride and cultural identity. With the globalization process, the talents who are good at no less than two languages and have a profound understanding of diverse cultures constitute valuable national resources. They can make substantial contributions to economic development, diplomacy, and international trade. Bilingual education can also enhance students' academic performance. Because bilinguals need to constantly monitor, select, and inhibit two language systems in daily communication, their brain functions are effectively trained, and their information processing capacity is enhanced. As a result, it enhances students' capacity to acquire and integrate new knowledge. Bilingual education constitutes a practical educational strategy, its implementation in classrooms can cultivate students' cross-cultural competence and improve their academic performance to a certain degree. Implementing bilingual education represents a crucial measure in contemporary educational practice.

3. Case study

In this section, two experiments which was conducted by Zhenhua Ji who graduated from Hebei Normal University [5] are analyzed. The reason for analyze his experiments lies in the fact that Ji adopted bilingual instruction in physics classes, which aligns with the core concept of bilingual education.

3.1. Hooke's law bilingual teaching experiment

The purpose of the first experiment was to implement bilingual (Chinese-English) instruction in physics classes to create an immersive English learning environment and enhance students' interest in both physics and English. The experiment investigated high school students who studied in Class 3 and Class 4, all of whom met the admission criteria for key high schools. The materials which were used in the experiment was a compulsory item in the revised version of the Full-time Regular Senior High School Curriculum (published by People's Education Press) and its accompanying English version. The topic of the class was Hooke's Law. The overall design of experiment was that firstly conducting bilingual education in class teaching, supplemented by multimedia tools (e.g., video recordings, audio recordings, projectors) and computer-assisted instruction. Secondly, self-study sessions were utilized to integrate bilingual (Chinese-English) learning, with students

encouraged to add English annotations to physics-specific vocabulary to facilitate memory retention. Thirdly, encouraging students to come to the school's electronic reading room during after-school hours to retrieve English-language physics-related resources online. After that, the researchers distributed survey questionnaires gather students' feedback.

After the experiments, the analysis and statistical results of students' homework are shown in Figure 1.

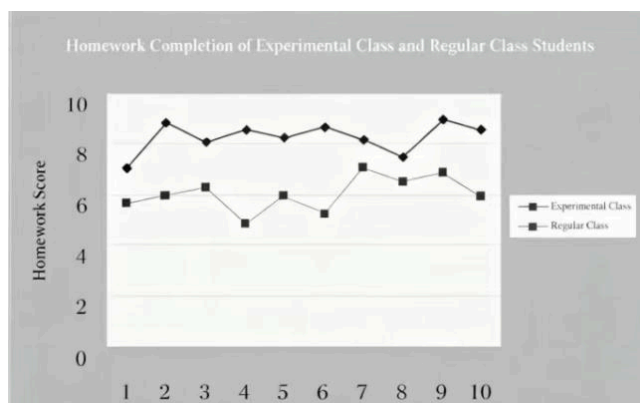


Figure 1: The homework situation of experimental class and regular class [5]

It can be found from the figure that the scores of the students who came from experimental class remained consistently high (no less than 7 points) and were significantly higher than those of students in the regular class. This result gives the information that bilingual education facilitates the learning of non-linguistic subjects rather than hindering it. It allows students to acquire physics knowledge efficiently and deepen their understanding of the subject through bilingual support. Thus it can be seen that bilingual education enhances students' interest in physics and increases their engagement in non-linguistic subject learning.

Apart from that, the researchers also conducted an in-depth survey via questionnaires to examine students' learning experiences. The survey shows that firstly bilingual teaching was widely accepted by most high school students. Secondly, more than 90% students agreed that using both languages in class had no adverse impact on their physics learning and instead offered benefits for improving learning efficiency and interest. Thus, using bilingual education can encourage students to devote greater attention to non-linguistic subjects, enhances their learning efficiency, and accelerates their knowledge acquisition in these subjects, rather than impeding their learning.

3.2. Merit bilingual teaching experiment

For the second experiment, the instructional approach gradually shifted towards immersive bilingual teaching. Immersive bilingual teaching refers to instruction conducted entirely in the target language (English) proficiently acquired by students, with no recourse to their mother tongue. The experiment subjects were high school students from Class 3 and Class 4. The topic of the class was the merit, and the experiment aimed to optimize physics instruction within a foreign language context through bilingual teaching, while creating an immersive foreign language learning environment to enhance students' comprehensive competencies

The results were derived from statistical analysis and comparison of the physics and English test scores of first-year high school students since their enrollment. The result is shown in Figure 2.

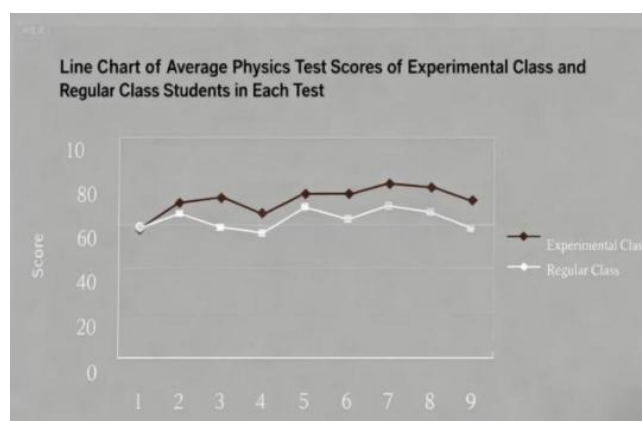


Figure 2: Line chart of average physics test scores of experimental class and regular class students in each test [5]

As indicated in Figure 2, students in the experimental class initially achieved similar academic performance to those in the regular class. However, with the implementation of bilingual education, the experimental class demonstrated superior academic performance, with average scores marginally exceeding 60 points, and exhibited an overall upward trend compared to the regular class. It can be seen from the result that bilingual education exerts a positive influence on students' academic outcomes. Specifically, students achieved higher test scores due to improved knowledge acquisition efficiency and enhanced learning effectiveness. As a result, one of the prominent advantages of bilingual teaching is its ability to facilitate the improvement of students' academic performance.

3.3. Discussion

However, these two experiments have certain limitations. The experiment subjects were students who met the admission criteria for key high schools, possessing a solid English proficiency foundation. These two experiments did not explore whether bilingual education enhances the learning capabilities of students with average academic backgrounds, so the experiments are not extensive. In the future, large-scale quantitative studies with expanded samples should be adopted to validate the conclusions, and multi-case comparative analyses are recommended.

Despite for the limitations, these experiments yield valuable findings and practical implications for both teachers and students. Firstly, bilingual teaching can improve students' learning interests in learning non-language subject and encourage students to take more attention to non-language subject. Secondly, it effectively promotes students' learning efficiency in non-linguistic subjects rather than hindering their learning progress. Thirdly, it is able to enhance students' academic results and allow students to get better scores in examination. Those experiments demonstrate the significant value of bilingual education in enhancing high school students' learning capabilities in non-linguistic subjects.

4. Suggestions

Bilingual teaching is playing a pivotal role in the advancement of modern education. In order to improve the profound effect on students' learning, there are some suggestions which can be proposed to optimize bilingual education practices in the future.

Firstly, the professional capacity of teaching teams requires further enhancement. To illustrate, teachers play a significant role in teaching process so that their level of subject and language

proficiency is fundamental to effective knowledge transmission. In order to improve teachers' abilities, it is practical for them to regular training and international exchange to cultivate their bilingual ability and cross cultural teaching literacy. Secondly, the importance of optimizing the diversified evaluation system also merits emphasis. In other words, evaluation system takes an important place in teaching process because it serves to assess the effectiveness of instructional practices and students' progress under this teaching model. To adapting to the characteristics of bilingual teaching with multicultural backgrounds, the evaluation system need to be diverse. It is also useful to adopt a combination of process based and outcome based evaluation methods. This approach enables clear tracking of students' learning processes and outcomes, ensuring that instructional results align with educational objectives. Thirdly, it is useful to operate artificial intelligence. This is because AI can generate more precise outcomes and optimize human resource allocation. For example, AI can be used in the process of evaluation system to make a clear and accurate evaluation results. Also, it can be used to give some suggestions on making plan of bilingual education. Teachers can then integrate these AI-generated insights with their professional expertise to achieve superior instructional outcomes.

Bilingual education is still in the developmental stage with substantial room for improvement. Improvements can be made in teacher training, the optimization of diversified evaluation systems, and the integration of AI into instructional practices. If we can improve bilingual teaching strategies from multiple aspects, bilingual education will exert an even more profound influence on education

5. Conclusion

This study aimed to analyze the role of bilingual teaching strategies in enhancing high school students' comprehensive competencies in non-linguistic subject acquisition. Through a review and analysis of two experiments, three key conclusions were derived. The first conclusion is bilingual education facilitates non-linguistic subject learning rather than hindering it. Secondly, bilingual education enhances students' interest in non-linguistic subjects, motivating their active participation and increased engagement in related classes. Thirdly, bilingual education exerts a positive impact on students' academic performance.

This study holds practical significance because it highlights the positive effects of bilingual education and contributes to the advancement of instructional methodologies. Also, it focus on students' feedback on bilingual education and students' attitudes towards bilingual education so that people can see the effect of bilingual teaching on students' learning process more clearly. Apart from those, this essay which focuses on effect of bilingual teaching also encourages the adoption of bilingual teaching methods in daily instruction to enhance students' learning interest and capabilities. However, this study also has certain limitations. For example, the experiments only focus on top students who have wonderful English foundation so that the experiment has certain reference value but lacks universality. In the future, it is necessary to investigate the learning outcomes of students with average academic backgrounds under bilingual teaching and design targeted experiments for this group.

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