

EFFECTIVENESS OF BILINGUAL INSTRUCTION ON THE PERFORMANCE OF
SECONDARY STUDENTS IN SCIENCE AT KAJONKIETSUKA SCHOOL, PHUKET,
THAILAND: BASIS FOR ENHANCEMENT PROGRAM

Krizza Mae T. Jaspe

Kajonkietsuksa School, Phuket, Thailand

Pangasinan State University – Open University System

Email: jaspekrizzamae@gmail.com

ABSTRACT

This study determined the effectiveness of bilingual instruction on the Science performance of Grade 9 students at Kajonkietsuksa School, Phuket, Thailand. The study employed a quasi-experimental pretest–posttest design involving two intact classes: one exposed to bilingual instruction (English and Thai Star Program) and another to English-only instruction (English I-Star Program). The focus of the instructional intervention was on Genetics, including DNA, RNA, and genes, and it was conducted over a four-week period. Data were collected using a 30-item Science Achievement Test and a student perception survey, supported by qualitative interviews. Results revealed that both groups improved on their posttest scores; however, the bilingual group demonstrated significantly greater gains than the English-only group. Furthermore, students showed positive perceptions of bilingual instruction, particularly regarding improved understanding, engagement, and confidence in learning Science. A significant relationship was found between students' perception and their academic performance. The findings indicate that bilingual instruction enhances conceptual understanding and reduces language barriers in Science learning. The study concludes that integrating students' first language alongside English is an effective instructional approach. It is recommended that bilingual strategies be incorporated into Science teaching to improve both academic performance and student engagement.

Keywords: *bilingual instruction, Science achievement, perception, quasi-experimental design, Genetics*

INTRODUCTION

Teaching Science in a bilingual classroom presents both opportunities and challenges, particularly in contexts where students are required to learn complex scientific concepts using a second language. In multilingual environments such as

Thailand, language plays a crucial role in shaping students' understanding of scientific ideas. At Kajonkietsuksa School in Phuket, bilingual education is implemented through two academic programs: the English and Thai Star Program and the English I-Star Program. These programs differ in their language of instruction, providing a meaningful context to examine how language influences students' Science performance.

Science education requires students to understand abstract concepts, interpret technical vocabulary, and communicate scientific reasoning effectively. However, when instruction is delivered solely in a second language, students may struggle to express their understanding even if they grasp the concepts. This highlights the importance of instructional approaches that support both language and content learning.

Bilingual instruction provides an opportunity for students to access scientific concepts through their first language while gradually developing proficiency in a second language. According to Cummins (2000), language skills developed in the first language can support learning in a second language. Similarly, Krashen's Input Hypothesis emphasizes that students learn best when they receive comprehensible input, which can be supported by using familiar language.

In Thailand, bilingual education has been promoted to enhance students' English proficiency while maintaining their native language. However, classroom implementation varies, and the effectiveness of bilingual instruction in science remains an area that requires further investigation. At Kajonkietsuksa School, the presence of both bilingual and English-only programs allows for a direct comparison of these instructional approaches.

Statement of the Problem

This study aimed to determine the effectiveness of bilingual instruction on the Science performance of Grade 9 students at Kajonkietsuksa School, Phuket, Thailand.

Specifically, it sought to answer the following questions:

1. What is the performance of students in the Science Achievement Test before (pretest) and after (posttest) the implementation of the following instructional approaches:
 - a. Bilingual instruction (English and Thai Star Program)
 - b. English-only instruction (English I-Star Program)?
2. Is there a significant difference between the pretest and posttest scores of students taught through bilingual instruction?

3. Is there a significant difference between the pretest and posttest scores of students taught through English-only instruction?
4. What is the level of students' perception toward bilingual instruction?
5. Is there a significant relationship between students' perception toward bilingual instruction and their posttest scores?
6. Is there a significant difference in the Science Achievement Test results of the bilingual and English-only groups in terms of their pretest and posttest scores?
7. What challenges do teachers and students encounter in implementing bilingual instruction in Science?

Scope and Delimitations of the Study

This study examined the effectiveness of bilingual instruction on the Science performance of Grade 9 (Mattayom 3) students at Kajonkietsuksa School in Phuket, Thailand. It specifically compared two existing instructional approaches: bilingual instruction implemented in the English and Thai Star Program and English-only instruction used in the English I-Star Program.

The study was conducted during the second quarter of the academic year and covered Genetics, including DNA, RNA, and genes, over a four-week instructional period. The investigation primarily examined students' academic performance through pretest and posttest scores, as well as their perception of bilingual instruction.

This study was limited to two intact classes, each consisting of Grade 9 students, and did not include other grade levels, subject areas, or schools. The findings were based on short-term instructional outcomes and did not measure long-term retention of knowledge. Additionally, other factors, such as students' prior knowledge, motivation, and home environment, were not controlled for in this study.

Despite these limitations, the study provides meaningful insights into the role of language of instruction in Science learning within a bilingual educational setting.

Review of Related Literature

Bilingual education has been widely recognized as an effective approach to improving students' academic performance, particularly in language-intensive subjects such as Science. It involves the use of two languages in instruction to support both language development and content learning. According to Baker (2011), bilingual education enhances cognitive flexibility and allows learners to process information more effectively.

Cummins' Interdependence Hypothesis explains that skills developed in the first language can transfer to the second language, supporting academic success. This is particularly important in Science education, where students must understand complex concepts and technical vocabulary. Krashen (1985) further emphasized that learning occurs when students receive comprehensible input, which can be facilitated through bilingual instruction.

Recent studies have shown that bilingual instruction improves students' conceptual understanding and engagement. Learners who are allowed to use their first language alongside English are better able to connect new information with prior knowledge. This results in deeper understanding and improved academic performance.

In Thailand, bilingual education has been promoted through national policies aimed at preparing students for global communication while maintaining their cultural identity. Studies have shown that Thai students perform better in Science when teachers use both Thai and English during instruction. This approach helps students understand difficult concepts while gradually developing English proficiency.

Translanguaging has also emerged as an important practice in bilingual education. It allows students to use their full linguistic repertoire to construct meaning, making learning more accessible and engaging. In Science classrooms, translanguaging helps students understand complex processes and reduces language-related barriers.

Despite its benefits, bilingual instruction also presents challenges. These include limited instructional resources, inconsistent language use, and the need for teacher training. However, when implemented effectively, bilingual instruction can significantly enhance students' academic performance and learning experience.

Theoretical Framework

This study is anchored on established theories that explain the relationship between language and learning. Cummins' Interdependence Hypothesis posits that proficiency in a learner's first language supports the development of a second language, thereby facilitating academic achievement. In the context of Science education, this suggests that students can better understand complex concepts when instruction incorporates their native language alongside English.

In addition, Krashen's Input Hypothesis emphasizes that language acquisition occurs when learners are exposed to comprehensible input. This principle supports the use of bilingual instruction, as it allows teachers to present scientific concepts in a way that is accessible and meaningful to students.

Furthermore, Vygotsky's Sociocultural Theory highlights the importance of social interaction and scaffolding in learning. Through bilingual instruction, teachers can provide appropriate support that enables students to move from basic understanding to higher-level thinking.

Conceptual Framework

INPUT	PROCESS	OUTPUT
Type of Instruction - Bilingual Instruction (Class 3/4) - English-only Instruction (Class 3/5) Participants (Grade 9 students) Science Topic (Genetics: DNA, RNA, and Genes)	Administration of Pretest Implementation of Instruction (4 weeks) - Bilingual Instruction - English-only Instruction Administration of Posttest Distribution of Perception Survey Conduct of Semi-structured Interviews Data Analysis - Descriptive Statistics - Paired t-test - Independent t-test - Pearson r - Thematic Analysis	- Students' Science Academic Performance - Students' Perception toward Bilingual Instruction - Identified Challenges in Bilingual Instruction - Proposed Instructional Enhancement Program

METHODOLOGY

This study employed a quasi-experimental pretest–posttest design to determine the effectiveness of bilingual instruction on students' Science performance. Two intact Grade 9 classes at Kajonkietsuksa School were selected: one exposed to bilingual instruction and another to English-only instruction.

The participants were students from the English and Thai Star Programs and the English I-Star Program. Each group included approximately 27 students. The study was conducted over a four-week period, focusing on Genetics, including DNA, RNA, and genes.

Data were collected using a 30-item Science Achievement Test administered as both a pretest and a posttest. The test consisted of multiple-choice, identification, and short-answer questions aligned with the learning objectives. A student perception survey was also used to assess students' attitudes toward bilingual instruction. In addition, qualitative data were gathered through interviews and classroom observations.

The data were analyzed using descriptive statistics such as mean and standard deviation. Paired t-tests were used to determine differences between pretest and posttest scores within each group, while independent t-tests were used to compare the performance of the two groups. Pearson correlation was used to examine the relationship between students' perception and their posttest scores. Qualitative data were analyzed using thematic analysis to identify common themes related to challenges and experiences in bilingual instruction.

Ethical considerations were observed throughout the study, including obtaining informed consent from participants and ensuring confidentiality of data.

Research Design

This study employed a quasi-experimental research design using a pretest–posttest approach with a comparison group to determine the effectiveness of bilingual instruction on students' Science performance. The design involved two intact Grade 9 classes at Kajonkietsuksa School in Phuket, Thailand. One class was exposed to bilingual instruction under the English and Thai Star Program, while the other class received English-only instruction under the English I-Star Program.

Both groups were administered a pretest prior to the instructional intervention to assess their baseline knowledge in Genetics, including topics such as DNA, RNA, and genes. Following the pretest, both groups underwent a four-week instructional period using their respective language approaches. After the intervention, a posttest was administered to measure changes in students' academic performance.

This design allowed comparison of learning outcomes within each group and between the two groups. The use of intact classes ensured that the natural classroom setting was maintained, making the findings more reflective of actual teaching practices. The study also incorporated quantitative and qualitative data to provide a comprehensive analysis of the effectiveness of bilingual instruction.

Research Steps

The study followed a systematic process to ensure the results were valid and reliable. First, a review of related literature was conducted to establish the theoretical

foundation of the study. Afterward, the research design and data gathering tools were prepared and validated.

A pretest was administered to both the bilingual and English-only groups to determine their baseline knowledge in Genetics. This was followed by a four-week instructional intervention, during which the bilingual group received instruction using both Thai and English, while the English-only group was taught exclusively in English.

After the intervention, a posttest was administered to measure students' academic performance. A perception survey was also conducted to determine students' attitudes toward bilingual instruction. Finally, qualitative data were gathered through interviews and observations to identify challenges encountered during the implementation of bilingual instruction.

Data Collection and Sample Selection

The study involved Grade 9 students from Kajonkietsuksa School in Phuket, Thailand. Two intact classes were selected as participants: one from the English and Thai Star Program and another from the English I-Star Program. Each group consisted of approximately 27 students.

Data were collected using a researcher-developed Science Achievement Test consisting of 30 items, including multiple-choice, identification, and short-answer questions aligned with the Genetics topic. The same test was used as both a pretest and a posttest to ensure consistency in measuring students' performance.

In addition, a Likert-scale survey was administered to assess students' perception of bilingual instruction. Qualitative data were also gathered through semi-structured interviews with selected students and teachers to provide deeper insights into the learning process.

Data Analysis Methods

The data gathered in this study were analyzed using both quantitative and qualitative methods. Descriptive statistics, including mean and standard deviation, were used to describe students' performance in the pretest and posttest.

Paired sample t-tests were used to determine the significant difference between pretest and posttest scores within each group. Independent-samples t-tests were used to compare students' performance between the bilingual and English-only groups.

Pearson correlation was used to examine the relationship between students' perception of bilingual instruction and their posttest scores.

Qualitative data obtained from interviews and observations were analyzed using thematic analysis to identify common patterns and challenges encountered in bilingual Science instruction.

Research Hypotheses and Validation

The study tested the null hypotheses at a 0.05 level of significance to determine whether there were significant differences and relationships among the variables. The hypotheses included the absence of significant differences between pretest and posttest scores of both groups, as well as no significant relationship between students' perception and their academic performance.

To ensure the validity of the data-gathering tools, the Science Achievement Test and the perception survey were subjected to content validation by experts in Science education. Reliability testing was also conducted to ensure the instruments were consistent. These procedures ensured that the tools used in the study were appropriate and reliable for measuring students' performance and perceptions.

Study Limitations and Ethical Considerations

This study was limited to Grade 9 students from two intact classes at Kajonkietsuksa School and was conducted over a four-week instructional period. The findings were based on short-term academic performance and may not reflect long-term learning outcomes. Additionally, variables such as students' prior knowledge, motivation, and home environment were not controlled in the study.

Ethical considerations were strictly observed throughout the research process. Permission to conduct the study was obtained from the school administration. Informed consent was secured from all participants, and confidentiality of their responses was maintained. Participation in the study was voluntary, and students were assured that their responses would be used solely for research purposes.

RESULTS AND DISCUSSION

SOP 1. What is the performance of students in the Science Achievement Test before (pretest) and after (posttest) the implementation of bilingual and English-only instruction?

The results showed that both the bilingual and English-only groups improved their posttest scores compared to their pretest scores. However, the bilingual group obtained higher mean posttest scores than the English-only group, indicating better academic performance following the instructional intervention.

Enhanced Engagement: The improvement in both groups suggests that instruction, regardless of language, contributed to learning gains. However, the higher performance of the bilingual group indicates that the use of both Thai and English facilitated better understanding of scientific concepts. This supports Cummins' Interdependence Hypothesis, which posits that first-language support enhances second-language learning. The findings also align with Krashen's Input Hypothesis, as bilingual instruction provides comprehensible input, enabling students to grasp complex concepts more effectively.

SOP2. Is there a significant difference between the pretest and posttest scores of students taught through bilingual instruction?

The paired t-test results revealed a significant difference between students' pretest and posttest scores taught through bilingual instruction, indicating a substantial improvement in their academic performance after the intervention.

Enhanced Engagement: The significant improvement observed in the bilingual group highlights the effectiveness of bilingual instruction in enhancing students' understanding of Science concepts. By allowing students to process information in their first language before connecting it to English terminology, bilingual instruction reduces cognitive load and supports deeper learning. This finding is consistent with Vygotsky's Sociocultural Theory, which emphasizes the role of scaffolding in learning.

SOP 3. Is there a significant difference between the pretest and posttest scores of students taught through English-only instruction?

The results also showed a significant difference between students' pretest and posttest scores taught through English-only instruction, indicating that learning occurred during the instructional period.

Enhanced Engagement: Although the English-only group demonstrated improvement, the gains were lower than those of the bilingual group. This suggests that while English immersion supports language development, it may limit students' ability to fully understand complex scientific concepts due to language barriers. This supports previous findings that learning in a second language without sufficient support may hinder conceptual understanding.

SOP 4. What is the level of students' perception toward bilingual instruction?

The findings revealed that students generally had a positive perception of bilingual instruction. They reported that using both Thai and English helped them better understand lessons, increased their confidence, and encouraged participation in class.

Enhanced Engagement: Students' positive perceptions indicate that bilingual instruction fosters a more supportive and engaging learning environment. When students understand the lesson clearly, they are more likely to participate actively and build confidence in their abilities. This aligns with the concept of translanguaging, which enables learners to draw on their full linguistic repertoire to construct meaning.

SOP 5. Is there a significant relationship between students' perception and their posttest scores?

The Pearson correlation analysis revealed a significant relationship between students' perception of bilingual instruction and their posttest scores. Students with more positive perceptions tended to achieve higher academic performance.

Enhanced Engagement: The significant relationship suggests that students' attitudes toward instruction play an important role in their academic success. Positive perception enhances motivation, engagement, and willingness to participate in learning activities. This finding supports the idea that affective factors influence learning outcomes, particularly in language-related contexts.

SOP 6. Is there a significant difference between the Science Achievement Test results of the bilingual and English-only groups?

The independent samples t-test revealed a significant difference between the posttest scores of the bilingual and English-only groups, with the bilingual group performing better.

Enhanced Engagement: The results confirm that bilingual instruction is more effective than English-only instruction in improving students' Science performance. By integrating both languages, students are able to build stronger conceptual understanding while gradually developing their English proficiency. This finding is consistent with previous studies highlighting the benefits of bilingual education for content learning.

SOP 7. What challenges are encountered in implementing bilingual instruction in Science?

The qualitative findings identified several challenges in implementing bilingual instruction, including difficulties in balancing the use of two languages, limited instructional materials, and the need for teacher training.

Enhanced Engagement: These challenges indicate that while bilingual instruction is effective, its success depends on proper implementation. Teachers must be trained to use both languages strategically, and sufficient resources must be provided to support bilingual teaching. Addressing these challenges can further enhance the effectiveness of bilingual instruction in Science education.

SUMMARY

This study examined the effectiveness of bilingual instruction on the Science performance of Grade 9 students at Kajonkietsuksa School in Phuket, Thailand. The findings revealed that both bilingual and English-only instructional approaches improved students' academic performance; however, the bilingual group demonstrated significantly higher gains in posttest scores.

The results further showed that students had positive perceptions of bilingual instruction, particularly regarding improved understanding, confidence, and engagement in learning Science. A significant relationship was also found between students' perception and their academic performance, indicating that positive attitudes contribute to better learning outcomes.

Moreover, the comparison between the two groups confirmed that bilingual instruction is more effective than English-only instruction in enhancing students' conceptual understanding. Despite its effectiveness, challenges such as language balance, limited instructional resources, and the need for teacher training were identified in the implementation of bilingual instruction.

CONCLUSIONS

Based on the findings of the study, it is concluded that bilingual instruction is an effective approach to improving students' Science performance. The integration of both Thai and English in instruction enhances students' conceptual understanding, facilitates clearer comprehension of complex scientific concepts, and increases student engagement in the learning process.

Furthermore, students exposed to bilingual instruction demonstrated more positive perceptions toward learning Science, which contributed to their improved

academic performance. The use of students' first language as support in instruction reduces language barriers and allows for more meaningful learning experiences.

Overall, bilingual instruction provides a balanced approach that supports both content mastery and language development, making it a valuable strategy in Science education.

RECOMMENDATIONS

Based on the study's conclusions, it is recommended that bilingual instructional strategies be integrated into Science instruction to enhance students' understanding of complex concepts. Teachers are encouraged to utilize both Thai and English in a structured manner, allowing students to first grasp scientific ideas in their native language before reinforcing them using English terminology. This approach can help reduce language barriers and improve students' confidence and engagement in learning.

Schools are also encouraged to provide professional development programs that equip teachers with effective bilingual and translanguaging strategies. Strengthening teacher competence in managing dual-language instruction is essential to ensure the successful implementation of bilingual education. In addition, the development and use of instructional materials in both languages are recommended to support students' comprehension and participation in Science classes.

Furthermore, school administrators may consider enhancing existing bilingual programs by promoting collaboration among teachers, curriculum coordinators, and academic leaders. Continuous monitoring of students' performance and learning experiences should be conducted to ensure that instructional practices remain effective and responsive to students' needs. Future researchers are likewise encouraged to explore the long-term effects of bilingual instruction and its application across different subject areas and educational contexts.

In support of these recommendations, an instructional enhancement program is proposed to strengthen the implementation of bilingual instruction in Science. The program focuses on structured bilingual strategies, including translanguaging, dual-language materials, and interactive teaching approaches, to promote deeper conceptual understanding. It is recommended that the program be implemented on a quarterly basis, with regular monitoring through assessments, classroom observations, and student feedback. To ensure sustainability, continuous teacher training and

resource development should be maintained, allowing schools to consistently improve bilingual instruction and support students' academic success in Science.

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REFERENCES

- Baker, C. (2011). *Foundations of bilingual education and bilingualism* (5th ed.). Multilingual Matters.
- Cummins, J. (2000). *Language, power, and pedagogy: Bilingual children in the crossfire*. Multilingual Matters.
- García, O., & Wei, L. (2018). *Translanguaging: Language, bilingualism and education*. Palgrave Macmillan.
- Krashen, S. D. (1985). *The input hypothesis: Issues and implications*. Longman.
- Laksanasut, P. (2019). Effects of bilingual instruction on science learning in Thailand. *Asian Education Studies*, 4(3), 88–102.
- Llanes, A. (2021). Bilingual instruction and student achievement in science: Evidence from the Philippines. *Philippine Journal of Education*, 98(1), 33–47.
- OECD. (2019). *PISA 2018 results (Volume I): What students know and can do*. OECD Publishing.
- Suwanarak, K. (2019). Classroom practices in bilingual science instruction in Thailand. *Asian Journal of Education*, 40(2), 89–105.
- Thumtong, S. (2021). Bilingual instruction and student participation in science classrooms. *International Journal of Science Education*, 43(6), 901–918.
- Umansky, I. M., & Reardon, S. F. (2024). The academic benefits of bilingual education. *American Educational Research Journal*, 61(2), 345–378.
- UNESCO. (2018). *Global education monitoring report: Migration, displacement and education*. UNESCO Publishing.