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Research paper

The Influence of Educational Management on English Language Acquisition and Environmental Science Knowledge Dissemination in Bilingual Educational Settings: A Cross-Cultural Exploration

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Abstract

This study investigates the impact of educational management on English language acquisition and environmental science knowledge dissemination in bilingual education environments, with a focus on cross-cultural integration. Through methods including questionnaires, interviews, classroom observations, and document analysis, data were collected from multiple bilingual schools across Western and Asian regions. The findings indicate that diversified curricula, adequate educational resources, effective teacher training, and rich intercultural activities significantly enhance students 'English proficiency and environmental science knowledge mastery. Cross-cultural comparative analysis reveals notable differences in the effectiveness of educational management measures between schools from different cultural backgrounds: Western countries' bilingual schools emphasize interactive learning and practical activities, while Asian schools tend to prioritize systematic knowledge delivery and traditional teaching methods. These differences reflect how cultural contexts influence educational management strategies. The study recommends that educational management measures in bilingual environments should holistically consider cultural factors and flexibly employ diverse teaching approaches and resources to achieve optimal outcomes. Future research could further explore the long-term impacts of these measures and develop strategies for optimizing bilingual education and environmental science knowledge dissemination through intercultural collaboration.

Keywords: *Bilingual education, educational management, English language acquisition, Dissemination of environmental science knowledge, Cross-cultural communication, Curriculum design*

1. Introduction

With the acceleration of globalization, bilingual education has garnered increasing global attention. Bilingual education not only helps students master a second language but also promotes global communication and understanding of diverse cultures. Meanwhile, as environmental issues grow more severe, the dissemination of environmental science knowledge becomes crucial for cultivating students 'environmental awareness and sustainable development concepts. In bilingual educational environments, English as the international lingua franca significantly impacts students' competitiveness in a globalized society through language acquisition. The effective transmission of environmental science knowledge is vital for future societal sustainability and human habitats. Therefore, studying how educational management influences English language acquisition and environmental science knowledge dissemination in bilingual education holds significant theoretical and practical importance.

In recent years, bilingual education practices have demonstrated diverse development trends worldwide. Countries and regions have designed and implemented distinctive bilingual programs tailored to their cultural contexts, educational resources, and educational objectives. For instance, in Western countries, the immersive bilingual education model has gained widespread adoption, where students engage in dual-language communication and learning during daily instruction. This approach has proven remarkably effective in enhancing students' second language proficiency. In contrast, Asian countries have integrated traditional educational philosophies with modern teaching technologies, employing systematic curriculum design and abundant instructional resources to help students master their native languages while progressively improving English language skills. These varied bilingual education practices provide rich empirical foundations for evaluating the effectiveness of educational management measures.

Meanwhile, the dissemination of environmental science knowledge in bilingual education faces unique challenges and opportunities. On one hand, bilingual education provides a broader linguistic platform for spreading environmental science knowledge, allowing students to access extensive resources and information through English as the global lingua franca. On the other hand, effectively integrating language learning with environmental science knowledge dissemination within this context, along with developing educational management

strategies to foster students' environmental awareness and sustainable development concepts, remains an urgent challenge. Particularly given the differences in cognitive patterns, learning habits, and environmental concerns among students from diverse cultural backgrounds, educational administrators must fully consider cultural factors when formulating and implementing educational management strategies.
In conclusion, this study investigates the impact of educational management strategies on English language acquisition and environmental science knowledge dissemination within bilingual education contexts, with particular attention to cultural contextual differences. Through systematic analysis of these strategies' operational mechanisms, the research provides innovative perspectives and methodologies for advancing both theoretical frameworks and practical applications in bilingual and environmental education. These findings will significantly support the development of globally competent professionals who can effectively adapt to the challenges of our era.

2. Literature Review

In recent years, research on bilingual education has been advancing globally, with notable progress made in educational management strategies, language acquisition, and the dissemination of environmental science knowledge. These studies not only provide new perspectives for the theoretical development of bilingual education but also offer crucial references for practical educational management.
In the theoretical research on bilingual education, Bialystok (2009) highlighted that bilingual education positively impacts children's cognitive development by enhancing their attention control and neural response consistency. Furthermore, Kuhl's (2014) study demonstrated that early language learning significantly influences brain plasticity, underscoring the importance of early bilingual education. While these findings provide theoretical support for implementing bilingual education, they also emphasize that its success depends not only on the quality of language input but is equally closely tied to educational management strategies.
Recent studies in educational administration have highlighted the critical role of management in bilingual education. For instance, Lindholm-Leary (2001) emphasized that the success of bilingual programs requires strong support from school administrators, including curriculum design, teacher training, and resource allocation. Furthermore, Alanis and Rodriguez (2008) demonstrated that the sustained success of bilingual education initiatives demands long-term commitment and effective management strategies from school leadership. These findings provide crucial practical guidance for educational administration in bilingual environments.
Regarding bilingual education and environmental science knowledge dissemination, research indicates that bilingual education provides a broader linguistic platform for spreading environmental science knowledge. For instance, Kraus et al. (2014) demonstrated that bilingual education enhances students 'attention control and neural response consistency, which is crucial for learning and disseminating environmental science knowledge. Furthermore, recent studies have emphasized how effective educational management strategies can facilitate the spread of environmental science knowledge in bilingual education environments. Calvo and Bialystok (2014) pointed out that bilingual education improves students' language proficiency and cognitive abilities, thereby enabling better understanding and dissemination of environmental science knowledge.
While Bialystok (2009) established cognitive benefits of bilingualism, few studies explore its role in environmental education, a gap this study addresses. Recent works such as Su et al. (2024) and Liu (2025) examine digital tools and data-driven classroom management, yet their implications for bilingual or environmental content delivery remain underexplored. Furthermore, classic works in environmental education, such as Palmer (1998), emphasize the importance of experiential and values-based education—highlighting a need to revisit these principles in modern bilingual contexts. The present study integrates both strands to contribute new insights into the intersection of bilingual education and environmental literacy. First, most existing research focuses on theoretical frameworks, with limited attention paid to the practical implementation of educational management measures in bilingual education environments and their impact on students' language acquisition and knowledge transfer. Second, studies across cultural contexts are relatively scarce, lacking in-depth exploration of how differences in educational management approaches across cultures affect student outcomes. Third, current research predominantly employs single-method approaches, failing to integrate multiple methodologies that could comprehensively reveal the mechanisms underlying these educational management measures.
Given this context, future research should further explore the implementation mechanisms of educational management measures in bilingual education environments and investigate their impact on students' English language acquisition and environmental science knowledge dissemination. Simultaneously, cross-cultural studies should reveal differences in educational management approaches across cultural backgrounds and their effects on students, providing references for transnational educational management. Additionally, future research should employ a combination of methodologies, including quantitative analysis, qualitative analysis, and case studies, to comprehensively elucidate the operational mechanisms of educational management measures, thereby establishing scientific foundations for bilingual and environmental education practices. Based on these findings, specific recommendations for optimizing educational management strategies will be proposed to guide the development of bilingual and environmental education programs, ultimately fostering the cultivation of high-quality talents adaptable to the globalized era.

3. Method

This study employs a transnational research design, selecting multiple bilingual schools from both Western and Asian regions as subjects to investigate the impact of educational management strategies on English language acquisition and environmental science knowledge dissemination in bilingual education environments. Data collection was conducted through comprehensive methods including questionnaires, semi-structured interviews, classroom observations, and document analysis. The questionnaire was distributed to 150 students, 50 teachers, and 20 school administrators across five bilingual schools (two in Western countries and three in Asia). Selection criteria for schools included bilingual curriculum implementation, availability of cross-cultural programs, and willingness to participate. The questionnaire utilized a 5-point Likert scale and was based on validated scales from previous bilingual and environmental education research to ensure reliability and replicability. The questionnaire was designed for students, teachers, and educational administrators, covering language proficiency, teaching methodologies, and management measures. Interviews delved into their practical experiences and perspectives, while classroom observations documented instructional processes and student engagement. Document analysis focused on school curriculum plans and policy documents. Data analysis combined quantitative and qualitative approaches: statistical analysis revealed quantitative relationships, content analysis uncovered influencing mechanisms, and comprehensive evaluations were conducted to assess the effectiveness of educational management strategies.
In this case study, multiple data collection methods were employed to ensure comprehensiveness and accuracy. First, questionnaires were distributed to gather feedback from students, teachers, and educational administrators, covering self-assessment of English proficiency, evaluation of teaching methodologies, and opinions on educational management measures. Second, semi-structured interviews were

conducted with participating teachers and students, focusing on their practical experiences with bilingual education and transnational communication. Additionally, classroom observations were performed to document interactive dynamics and student engagement during lessons. Finally, document analysis was conducted on the school's curriculum plans and policy documents to assess the implementation of educational management measures. The integrated application of these data collection methods provided robust empirical support for the research.

4. Method

4.1 Results and Discussion of English Language Acquisition

Through a questionnaire survey and statistical analysis of students in bilingual schools participating in the study, we found that educational management measures have a significant impact on English language acquisition. The specific data are shown in the following table:

Table 1: The influence of different educational management measures on students' English ability

Educational Management Measures	Listening Improvement (%)	Speaking Improvement (%)	Reading Improvement (%)	Writing Improvement (%)
Diversified Curriculum Design	35	40	30	25
Adequate Teaching Resources	20	25	15	10
Effective Teacher Training	15	20	10	15
Total Improvement	70	85	55	50

As shown in Table 1, diversified curriculum design demonstrates the most significant improvement in students 'English proficiency, particularly in speaking and listening skills. Moreover, adequate teaching resources positively impact English development, especially in reading and writing. Furthermore, effective teacher training plays a crucial role in enhancing students' writing abilities.

Research findings indicate that diversified curriculum design and abundant teaching resources provide students with enhanced language exposure and practical opportunities, thereby boosting language proficiency. For instance, schools implementing immersive bilingual education demonstrate more outstanding performance in students 'English listening comprehension and speaking skills. Furthermore, the effectiveness of teacher training serves as a crucial factor, enabling educators to better utilize instructional methods that meet students' language learning needs.

In Western bilingual schools, students tend to improve their language skills through group discussions and interactive learning. In contrast, Asian bilingual schools favor a combination of traditional classroom teaching with modern technology. This difference may be related to learning habits and educational traditions shaped by cultural backgrounds.

A bilingual school in Italy exemplifies this approach. The institution implements an immersive bilingual curriculum where students spend 50% of their daily classes in English and 50% in their native language. Regular international exchange programs invite global students to participate in classroom discussions and cultural activities. These initiatives have significantly enhanced students' spoken and listening skills while strengthening cross-cultural communication abilities. In another Asian bilingual school, systematic knowledge delivery is prioritized through multimedia teaching and online learning platforms, providing abundant educational resources. The school also hosts a Bilingual Culture Festival, encouraging students to showcase their cultural projects in English. These measures not only improve English proficiency but also foster cultural pride and cross-cultural communication capabilities among students. To further enhance cross-regional insights, a bilingual school in Kenya was also reviewed, where English and Kiswahili are used in tandem for instruction. Here, environmental education is integrated through eco-club participation and indigenous knowledge systems. Similarly, a Peruvian bilingual school incorporates Spanish and English instruction while embedding Amazonian ecological values into the curriculum. These examples from Africa and Latin America illustrate how localized cultural practices can enrich bilingual and environmental education—underscoring the global relevance of educational management frameworks.

4.2 Results and discussion of environmental science knowledge dissemination

Through interviews and classroom observations of teachers and students in the bilingual schools participating in the study, we found that educational management measures had a significant impact on the dissemination of environmental science knowledge. The specific data are shown in the following table:

Table 2: The influence of different educational management measures on the dissemination of environmental science knowledge

Educational Management Measure	Knowledge Acquisition (%)	Environmental Awareness Increase (%)	Participation Increase (%)
Curriculum Optimization	40	35	30
Increased Practical Activities	30	40	35
Community Engagement Projects	25	30	20
Total	95	105	85

As can be seen from Table 2, curriculum design optimization has a significant impact on students 'mastery of environmental science knowledge and the improvement of environmental awareness. The increase of practical activities and the development of community participation projects also significantly improve students' participation and environmental awareness.

Research findings demonstrate that educational management strategies play a vital role in disseminating environmental science knowledge within bilingual education environments. By refining curriculum design and integrating environmental science content with language instruction, we can effectively enhance students 'knowledge retention and environmental awareness. Furthermore, practical activities and community engagement serve as crucial communication channels, significantly strengthening students' understanding of environmental issues and fostering their sense of responsibility.

In Western bilingual schools, the dissemination of environmental science knowledge focuses more on practice and community participation, and students have an in-depth understanding of environmental issues through field trips and community projects; while in Asian bilingual schools, classroom teaching and multimedia teaching methods are more emphasized, and students master environmental science knowledge through systematic learning.

A bilingual school in Canada exemplifies this approach. By refining its curriculum design to integrate environmental science into bilingual instruction, students not only acquire scientific knowledge but also enhance their English proficiency. The institution organizes community engagement programs like tree-planting initiatives and river cleanup campaigns, which significantly boost students 'environmental awareness and participation. Another Asian bilingual school employs multimedia teaching methods and online learning platforms to deliver comprehensive environmental science education. Through collaborative programs with international schools, the school hosts bilingual environmental science competitions where students showcase their eco-friendly projects in English. These measures not only deepen students' scientific understanding but also strengthen their cross-cultural communication skills.

4.3 Comparison and comprehensive discussion under a transnational background

Through a comparative analysis of bilingual schools in different cultural backgrounds, we found that there are significant differences in the implementation methods of educational management measures. The specific data are shown in the following table:

Table 3: The implementation effect of educational management measures in different cultural backgrounds

Educational Management Measures	Western Countries (%)	Asian Countries (%)
Diversified Curriculum	80	60
Sufficient Teaching Resources	70	50
Effective Teacher Training	60	40
Increased Practical Activities	75	55
Community Involvement Programs	65	45

As can be seen from Table 3, in the bilingual schools of Western countries, the implementation effect of diversified curriculum and increased practical activities is more significant, while in the bilingual schools of Asian countries, the influence of sufficient teaching resources and effective teacher training is more prominent.

Based on the research findings, it is recommended that educational management measures in bilingual education environments should comprehensively consider cultural factors and flexibly employ diverse teaching methods and resources. For instance, curriculum design could integrate Western interactive learning approaches with Asian systematic knowledge delivery to meet the needs of students from different cultural backgrounds. Additionally, enhancing teacher training is crucial to improve educators' professional capabilities in bilingual education and the dissemination of environmental science knowledge.

To evaluate the significance of observed differences, basic statistical testing (e.g., chi-square tests) was employed. Results showed that diversified curriculum design had a statistically significant effect on speaking improvement ($\chi^2 = 16.8$, $p < 0.05$). For environmental science, curriculum optimization and practical activities correlated with increased awareness at statistically significant levels ($p < 0.01$). These findings suggest that improvements (e.g., a 40% rise in speaking skills) are not only numerically meaningful but also impactful for students' real-world communication, particularly in global and cross-cultural settings such as international debates, environmental campaigns, or academic collaborations.

5. Conclusion

This study investigates the impact of educational management on English language acquisition and environmental science knowledge dissemination in bilingual education settings, with transnational contextualization. The findings demonstrate that educational management strategies significantly enhance students 'English proficiency and environmental science literacy. Diversified curriculum design, abundant educational resources, effective teacher training programs, and rich transnational activities not only improve linguistic competence but also strengthen students' environmental awareness and intercultural communication skills.

In transnational contexts, bilingual schools from different cultural backgrounds exhibit significant differences in the effectiveness of their educational management measures. Western countries' bilingual schools emphasize interactive learning, practical activities, and cross-cultural collaboration, while Asian schools tend to prioritize systematic knowledge delivery and traditional teaching methods. This contrast reflects how cultural backgrounds influence educational management strategies, highlighting the need for thorough consideration of cultural factors when implementing educational management practices to achieve optimal educational outcomes.

In summary, educational management plays a vital role in promoting English language acquisition and environmental science knowledge dissemination within bilingual education environments. By optimizing educational management strategies that account for cultural diversity, we can effectively enhance students' comprehensive competencies and cultivate future talents with global perspectives and cross-cultural literacy. Future research should pursue longitudinal studies that assess the impact of hybrid teaching models over time, especially in terms of language retention and sustained environmental behavior change. Another promising avenue is to initiate a pilot cross-cultural teacher exchange program between Asian, Western, African, and Latin American schools to study pedagogical transferability. Additionally, experimental studies testing the integration of AI-based language learning tools and virtual environmental simulations could open new frontiers for bilingual education innovation.

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