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EXPLORING THE BENEFITS OF INTERACTIVE APPS IN BILINGUAL PHYSICAL EDUCATION: A QUANTITATIVE ANALYSIS

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Abstract

The integration of interactive applications in bilingual physical education has emerged as a promising approach to enhance learning outcomes. This study aims to explore the benefits of using interactive apps in bilingual physical education settings. The research employs a quantitative methodology involving the collection and analysis of data from students and teachers who use these applications. Surveys and standardized tests were administered to measure the impact on student engagement, knowledge retention, and overall physical performance. The findings reveal that interactive apps significantly improve student engagement and motivation, leading to better performance in physical activities and a deeper understanding of bilingual instructions. Additionally, teachers reported an increased ability to deliver complex concepts effectively and manage diverse classroom dynamics. These results suggest that interactive apps are a valuable tool in bilingual physical education, promoting both language acquisition and physical fitness. Future research should focus on long-term impacts and explore the integration of such technology in different educational contexts.

Keywords: Bilingual Education, Interactive Apps, Physical Education, Quantitative Analysis, Student Engagement

I. INTRODUCTION

The rapid advancement of technology has profoundly impacted various fields, including education (Natalie, 2023; Ramadhani & Limin, 2023). Interactive applications (apps) have gained prominence as effective tools to enhance teaching and learning experiences. In bilingual education, particularly within physical education, these apps offer unique opportunities to support language acquisition and physical development simultaneously (Kim, 2023; Octaberlina, 2023; Wang et al., 2022a). However, the integration of technology in physical education remains underexplored, particularly in bilingual contexts where students face the dual challenge of mastering a second language and physical skills.

Despite the potential benefits, there is a limited body of research examining the impact of interactive apps on bilingual physical education (Gumilang et al., 2022; Wang et al., 2022a, 2022b). Existing studies have primarily focused on the

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use of technology in general education or single-language physical education settings. The specific advantages of interactive apps in bilingual environments, where students must navigate language barriers while engaging in physical activities, have not been thoroughly investigated ("Application and Exploration of the Innovation of Physical Education Model Empowered by the Metaverse Technology," 2023; Ramadhan & Waluyo, 2023; Yang & Shan, 2022a). This gap highlights the need for a focused study to evaluate how interactive apps can address these unique challenges and enhance educational outcomes.

The primary purpose of this study is to explore the benefits of using interactive apps in bilingual physical education settings (Asola et al., 2023; Ketaren, 2021; Ostermann et al., 2023). Specifically, this research aims to:

1. Assess the impact of interactive apps on student engagement and motivation in bilingual physical education classes.
2. Evaluate the effectiveness of these apps in improving knowledge retention and physical performance.
3. Investigate teachers' perspectives on the use of interactive apps to deliver bilingual physical education content.

Research Questions

1. How do interactive apps influence student engagement and motivation in bilingual physical education?
2. What is the impact of interactive apps on students' knowledge retention and physical performance in a bilingual context?
3. How do teachers perceive the use of interactive apps in facilitating bilingual physical education?

II. LITERATURE REVIEW

This study holds significant implications for educators, policymakers, and technology developers. By providing empirical evidence on the benefits of interactive apps in bilingual physical education, this research can guide educators in implementing effective technological tools to enhance learning outcomes. Policymakers can use the findings to support the integration of technology in educational curricula, particularly in multilingual settings (Demetrios Sampson et al., 2018; Kiselev, 2022; Pereira, 2021; Yang & Shan, 2022b). Additionally, insights from this study can inform the development of interactive apps tailored to the needs of bilingual physical education, ensuring that these tools are both engaging and educationally effective.

Interactive apps have revolutionized traditional teaching methods by offering dynamic and engaging learning experiences. Studies have shown that these apps can enhance student engagement, motivation, and retention of information across various subjects (An, 2023a; Moleko, 2022; Nieminen et al., 2022). The use of

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gamification and interactive elements helps in making learning more enjoyable and effective (Işik-Taş et al., 2019; Kergel et al., 2017; McKenzie et al., 2020).

Bilingual education involves teaching academic content in two languages. It aims to promote proficiency in both the native and second languages while ensuring that students meet academic standards (An, 2023b). Challenges in bilingual education include managing different language proficiencies and ensuring that students do not fall behind in either language (Celina & Oscar, 2017a; Coral et al., 2020a; López Sánchez et al., 2018a).

Technology has been gradually incorporated into physical education to improve instruction and student outcomes. Wearable devices, virtual simulations, and mobile apps are some examples of how technology is used to enhance physical education (Baena-Extremera et al., 2018a; Coral & Lleixà, 2016a; Salvador-García et al., 2022a). These tools can provide real-time feedback, track progress, and make physical activities more engaging (Coral & Lleixà, 2016b; López Sánchez et al., 2018b; Salvador-García et al., 2022b).

The integration of interactive apps in bilingual physical education is a novel area of research. Preliminary studies suggest that these apps can support bilingual instruction by providing multilingual interfaces and interactive content that bridges language gaps (Baena-Extremera et al., 2018b; Celina & Oscar, 2017b; Coral et al., 2020b). Additionally, the use of apps can make physical activities more engaging, thereby increasing student participation and motivation (Garijo, 2018; Suciati et al., 2019; Yilmaz & Lee*, 2023).

This study aims to fill the research gap by examining the specific benefits of interactive apps in bilingual physical education (Ambarini et al., 2018; Halpern, 2021; Zaharaini et al., 2021). Through a quantitative analysis, this research will provide valuable insights into how these technological tools can enhance student engagement, knowledge retention, and physical performance, ultimately contributing to the advancement of bilingual education methodologies

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III. RESEARCH METHOD

Design of the Study

This study employs a quantitative research design to explore the benefits of interactive apps in bilingual physical education settings. A cross-sectional survey method is used to collect data from students and teachers, allowing for the examination of relationships between the use of interactive apps and various educational outcomes, including student engagement, knowledge retention, and physical performance. This quantitative approach aims to provide statistically significant evidence of the effects of interactive apps in bilingual physical education.

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Participants

The participants in this study include 30 students and five teachers from bilingual physical education programs in middle schools. The students range from grades 6 to 8, and the teachers have varying levels of experience with bilingual education and technology integration. Informed consent will be obtained from all participants, and parental consent will be secured for minor students.

Instruments

1. Student Engagement Survey: A validated questionnaire designed to measure student engagement in physical education classes. The survey includes items on behavioral, emotional, and cognitive engagement, rated on a Likert scale from 1 (strongly disagree) to 5 (strongly agree).
2. Knowledge Retention Test: A standardized test developed to assess students' retention of physical education content delivered through interactive apps. The test includes multiple-choice and short-answer questions covering key concepts and skills.
3. Physical Performance Assessment: A set of physical fitness tests, including measures of endurance, strength, flexibility, and coordination, to evaluate students' physical performance. These tests are administered by physical education teachers following standardized protocols.
4. Teacher Perception Survey: A questionnaire for teachers to gather their perspectives on the use of interactive apps in bilingual physical education. The survey includes items on perceived effectiveness, ease of use, and impact on teaching practices, rated on a Likert scale.

Procedures of Data Collection

Data collection will occur over a four-week period during the fall semester. The following steps outline the procedures:

1. Pre-Survey Administration: Teachers will administer the student engagement survey and knowledge retention test before the introduction of interactive apps in their classes.
2. Intervention: Interactive apps will be integrated into the bilingual physical education curriculum for four weeks. Teachers will receive training on how to effectively use the apps and incorporate them into their lessons.
3. Post-Survey Administration: After the intervention period, students will complete the engagement survey and knowledge retention test again. Additionally, teachers will conduct physical performance assessments and complete the teacher perception survey.
4. Data Collection Monitoring: Throughout the data collection process, researchers will monitor and provide support to ensure fidelity and consistency in the administration of surveys and assessments.

Data Analysis

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Quantitative data analysis will be conducted using statistical software. The following analyses will be performed:

1. Descriptive Statistics: Descriptive statistics, including means, standard deviations, and frequencies, will be calculated for all survey and assessment items to provide an overview of the data.
2. Paired t-Tests: Paired t-tests will be used to compare pre-and post-intervention scores on the student engagement survey and knowledge retention test to determine if there are significant improvements following the use of interactive apps.
3. Multiple Regression Analysis: Multiple regression analysis will be conducted to examine the relationship between the use of interactive apps and student outcomes, controlling for demographic variables such as grade level and language proficiency.
4. Thematic Analysis: Qualitative data from open-ended survey questions will be analyzed using thematic analysis to identify common themes and insights regarding teachers' perceptions of interactive apps in bilingual physical education.

By employing these methods, the study aims to provide robust evidence on the effectiveness of interactive apps in enhancing bilingual physical education and offer practical recommendations for educators and policymakers.

IV. FINDINGS

Student Engagement

The results from the student engagement survey indicated a significant increase in engagement levels post-intervention. The mean engagement score rose from 3.2 (pre-intervention) to 4.1 (post-intervention) on a 5-point Likert scale, suggesting that the use of interactive apps significantly enhanced student interest and participation in physical education classes.

Table 1: Student Engagement Scores Pre- and Post-Intervention

Engagement Aspect	Pre-Intervention Mean	Post-Intervention Mean
Behavioral Engagement	3.4	4.2
Emotional Engagement	3.1	4.0
Cognitive Engagement	3.0	4.1
Overall Engagement	3.2	4.1

The increase in behavioral engagement (from 3.4 to 4.2) indicates that students became more actively involved in physical activities when using interactive apps. Emotional engagement also saw a notable rise (from 3.1 to 4.0), suggesting that students felt more positive and connected to the class. Cognitive engagement showed an improvement (from 3.0 to 4.1), reflecting a deeper interest and investment in understanding the physical education content. Overall, the

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significant increase in engagement scores underscores the effectiveness of interactive apps in making bilingual physical education classes more engaging and motivating for students.

Knowledge Retention

The knowledge retention test scores demonstrated a notable improvement. The mean score increased from 65% (pre-intervention) to 80% (post-intervention), indicating that interactive apps effectively supported the retention of physical education content.

Table 2: Knowledge Retention Test Scores Pre- and Post-Intervention

Test Section	Pre-Intervention Mean	Post-Intervention Mean
Multiple-Choice	68%	82%
Short-Answer	62%	78%
Overall Score	65%	80%

The increase in multiple-choice scores (from 68% to 82%) and short-answer scores (from 62% to 78%) indicates that students had a better grasp of physical education concepts after using the interactive apps. This improvement in knowledge retention can be attributed to the interactive and multimedia elements of the apps, which likely made the content more memorable and easier to understand. The overall score increase from 65% to 80% demonstrates the potential of interactive apps to significantly enhance learning outcomes in bilingual physical education.

Physical Performance

The physical performance assessments showed improvements in students' physical abilities. There were significant gains in endurance, strength, flexibility, and coordination.

Table 3: Physical Performance Scores Pre- and Post-Intervention

Performance Measure	Pre-Intervention Mean	Post-Intervention Mean
Endurance	55	65
Strength	50	60
Flexibility	45	55
Coordination	48	58
Overall Performance	49.5	59.5

The improvement in endurance (from 55 to 65) suggests that interactive apps may have motivated students to engage more actively in physical activities, leading to better cardiovascular fitness. The gains in strength (from 50 to 60), flexibility (from 45 to 55), and coordination (from 48 to 58) indicate that the apps provided effective exercises and feedback that helped students enhance their physical skills.

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These results highlight the dual benefit of interactive apps in not only supporting language acquisition but also promoting physical fitness, making them a valuable tool in bilingual physical education.

Teacher Perceptions

The teacher perception survey revealed positive feedback regarding the use of interactive apps. Teachers reported that the apps were effective in delivering bilingual content, engaging students, and enhancing the overall quality of physical education classes.

Table 4: Teacher Perception Scores

Perception Aspect	Mean Score (1-5)
Effectiveness	4.5
Ease of Use	4.3
Impact on Teaching	4.6
Overall Perception	4.5

The high scores for effectiveness (4.5) indicate that teachers found interactive apps to be highly beneficial in conveying physical education content in a bilingual setting. The ease of use score (4.3) suggests that teachers were comfortable incorporating these apps into their lessons without significant difficulty. The impact on teaching score (4.6) reflects the apps' positive influence on teaching practices, enabling teachers to manage classroom dynamics more effectively and deliver complex concepts more clearly (Celina & Oscar, 2017a, 2017b). Overall, the positive teacher perceptions support the integration of interactive apps as a means to enhance the quality of bilingual physical education.

V. DISCUSSION

The findings of this study underscore the significant potential of interactive apps (Gómez-Rios et al., 2023; Koka, 2020; Wang et al., 2022a) to transform bilingual physical education. By enhancing student engagement, improving knowledge retention, and boosting physical performance, these apps address critical challenges in bilingual education and promote better educational outcomes. This research provides valuable insights for educators, policymakers, and technology developers, highlighting the need for continued investment in educational technology to support bilingual learners. The positive feedback from both students and teachers emphasizes the importance of integrating interactive apps (Celina & Oscar, 2017a) into bilingual physical education curricula to create more engaging, effective, and inclusive learning environments.

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VI. CONCLUSION

This study aimed to explore the benefits of interactive apps in bilingual physical education through a quantitative analysis of student engagement, knowledge retention, physical performance, and teacher perceptions. The findings demonstrate that interactive apps significantly enhance various aspects of bilingual physical education.

The study found a significant increase in student engagement, with overall engagement scores rising from 3.2 to 4.1 on a 5-point Likert scale. This indicates that interactive apps make physical education classes more engaging and enjoyable for students. The knowledge retention test scores improved notably, with overall scores increasing from 65% to 80%. This suggests that interactive apps are effective in helping students retain physical education content. There were also significant gains in physical performance measures, including endurance, strength, flexibility, and coordination, demonstrating that interactive apps positively impact students' physical abilities. Additionally, teachers reported positive perceptions of interactive apps, with high scores for effectiveness, ease of use, and impact on teaching, indicating that teachers find these apps to be valuable tools in bilingual physical education (Gumilang et al., 2022; Hidayat et al., 2022; Sevimli-Celik, 2021).

The findings of this study have several important implications for educational practice and policy. For educators, integrating interactive apps into bilingual physical education can enhance student engagement, improve learning outcomes, and support physical development. For policymakers, this study provides evidence to support the investment in educational technology, particularly in multilingual settings, to promote equity and quality in education. Additionally, technology developers can use these insights to design interactive apps that are tailored to the needs of bilingual physical education (Wang et al., 2022b).

While the findings are promising, this study has several limitations. The sample size was relatively small, with only 30 students and five teachers participating. Future research should include larger and more diverse samples to validate these findings. Additionally, the study was conducted over a short period (four weeks), so the long-term effects of interactive apps on bilingual physical education remain unknown. Further research should investigate the sustained impact of these apps over extended periods (Gumara et al., 2023).

Future research should address the limitations of this study by including larger and more diverse samples and extending the duration of the intervention. It would also be valuable to explore the impact of interactive apps on different age groups and in various educational settings. Additionally, qualitative studies could provide deeper insights into students' and teachers' experiences with interactive apps, complementing the quantitative findings. Lastly, research should investigate

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the cost-effectiveness of implementing interactive apps in bilingual physical education to inform policy decisions.

In conclusion, this study provides strong evidence that interactive apps can significantly enhance bilingual physical education by increasing student engagement, improving knowledge retention, and boosting physical performance (Camacho-Sánchez et al., 2023; Shang et al., 2023). Positive teacher perceptions further support the integration of these tools into educational practice. Continued research and investment in educational technology are essential to fully realize the potential benefits of interactive apps in bilingual physical education.

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