SCIENTIFIC CULTURE

www.sci-cult.com

SCIENTIFIC CULTURE, Vol. 12, No. 5, (2026), pp. 617-628
Open Access. Online & Print

DOI: 10.5281/zenodo. 1250050

AI-ASSISTED LANGUAGE ACQUISITION IN SPORTS CONTEXTS: A MULTIMODAL APPROACH TO ENGLISH TEACHING FOR STUDENT-ATHLETES

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Received: **22/12/2025**
Accepted: **15/03/2026**

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ABSTRACT

Artificial intelligence (AI) in teaching language has transformative potential in the dynamic education environment, especially in specific disciplines like sports education. The research paper discusses a multimodal, AI-assisted system of teaching English as a second language (ESL) to student-athletes through current performance data, video feedback, sport-specific condition simulation, and the development of facilitated language acquisition in the context of the sporting scenario. Learners used a custom AI platform with natural language processing, speech recognition and motion tracking to solve tasks. They related their language input directly to their sports performance and communication with their team. The quasi-experimental design and randomised control trial involved 120 student-athletes in three institutions, with outcome measures contrasting results of traditional ESL instruction combined with the AI-based sports-language curriculum. It was found that the learners' vocabulary retention, communicative fluency, and motivation in the experimental group had shown statistically significant results. Qualitative results also pointed to a boost in engagement and confidence, and the translatability of language abilities into the sports realm. Such results show the potential of AI-driven domain-specific instruction to acquire language skills and athleticism, and the importance of embodied learning and contextualised communication to second language learning.

KEYWORDS: Artificial Intelligence; Sports Pedagogy; Multimodal Learning; English as a Second Language; Student-Athletes; Embodied Cognition.

1 INTRODUCTION

English mastery is now a necessity in the twenty-first century, with students all over the world having to acquire the skill, especially those who have been or will be exposed to international contexts in their education and career progression (Menggo et al., 2022). English is not only an academic field, since college students who play sports use it as a passport to explore the world. English language presence on international scholarships, service contracts and international tournaments have also established it further as the lingua franca of sport. Whether dealing with coaches, agents or teammates of varying backgrounds, communication in English is key to athletic and professional success. In the United States, the United Kingdom and other English-speaking nations, the number of universities with scholarship programs available to international applicants is not necessarily limited to the talented athlete, as a selection of different skills (e.g., English language proficiency) is sometimes necessary, such as passing a standardised test, currently IELTS or TOEFL (Yuzar et al., 2024). Lack of English language preparation can deny most athletes these opportunities, irrespective of their sporting ability.

The life of a student-athlete is characterised by special needs that distinguish them from traditional students in the university. Demands of strict training regimes, competitions and school fees make it difficult to create time to teach language in such ways that are found in conventional classes (Thompson et al., 2023). Student-athletes then need fresh ideas to ensure language learning becomes a part of their lived world instead of having to adjust to a generic ESL training system. That arena of sports itself one of commands, strategy planning, performance assessment, a natural context in which contextualised language use can occur. The second language learning under this environment presents not only efficiency but also relevance, in which an athlete has direct application of language toward situations presenting themselves as second nature to their future corporate lives (Huang & Tsai, 2024).

These contextual issues run in tandem with the soaring level of educational technology, which has occurred at a startling rate, with artificial intelligence (AI) being of particular transformative concern (Ireland, 2025). Natural language processing, speech recognition, and machine learning algorithms can create AI systems, which are also becoming common in English language teaching, allowing personalising learning, greater interactivity, and offering real-time feedback. Contemporary AI-powered ESL apps provide students with personalised learning tracks that will dynamically respond to their achievements. Indicatively, NLP algorithms can diagnose the writing of students, detect grammar mistakes and propose stylistic suggestions, whereas speech recognition engines measure pronunciation and fluency in a fashion that is comparable to that of a human instructor (Almanea, 2024).

Another significant development is the use of conversational AI, or chatbots, that replicate realistic communication scenarios. In contrast to a textbook level of dialogue, chatbots establish flexible, situation-specific text that replicates a real conversation (Abedin et al., 2025). They may be combined with iOS and Android applications or learning management systems to provide learners with on-demand training of speaking and listening skills. In addition, multimodal platforms with support of AI combined video, audio, and motion information and makes it possible to create an immersive experience that incorporates linguistic stimuli and visual and kinaesthetic information (Rakkolainen et al., 2021). These technologies, now backed by open-source libraries in Python (e.g. spaCy, NLTK, and TensorFlow), give researchers and educators an easily accessible tool to create specific interventions. Nevertheless, most AI languages, even in the field of ESL, are generic, designed to emphasise communication skills like business, academic writing, or conversational English. Very little work has been done to carry the AI-enhanced pedagogy into special tasks like sports and games, where language is closely coupled with embodied performance and quick thinking. This discrepancy presents a rationale to develop domain-specific AI-based learning environments that tie linguistic training to athletic communication requirements.

The conventional ESL teaching is based on general learners and, thus, is based on detached exercises and classroom dialogue (Norman & Eslami, 2024). Although useful teaching tactics in the general communicative competence, they usually do not cater to the particular situations when the learners will use their language knowledge. This presents a significant mismatch among student-athletes who might learn about general vocabulary and grammar, but are not ready to learn the fast-paced, embodied, and domain-specific communication as demanded in their future sports career. As a concrete illustration, in team sports like basketball or football, the athletes are required to interpret the tactical information, answer the commands and interactions with team members in real-time, and, most of the time, in pressure environments (Atasoy et al., 2021). Generic

ESL programs have seldom provided this environment to the learners, leaving them with theoretical knowledge of the English language but little ability to apply it.

Moreover, customary methods tend to regard language learning as an exclusively intellectual task unrelated to physical learning, body and experience. Yet theories of embodied cognition propose that what is impossible is learning without sensorimotor interaction. Actions, physical contexts, and gestures not only promote the process of communication but also improve retention and understanding (Andrä et al., 2020). Because this embodied dimension is ignored in conventional ESL approaches; ESL methods miss out on a significant source of language acquisition. The issue, then, is twofold: traditional ESL is not contextually grounded in the practice of athletic activities and does not acknowledge the promise of embodied, multimodal engagement to serve as a facilitator of such language acquisition.

This paper aims to bridge these gaps by proposing and testing an AI-supported multimodal ESL schema that will work with student-athletes. The framework encompasses natural language processing, speech recognition, and motion tracking to establish a direct connection between linguistic input on one hand and athletic performance and team/player communication on the other hand. Practically, it implies that learners perform the tasks a coach may refer to, including responding to coaching instructions, collaborating with team members in drills, or reflecting on video analyses of assessing their performance. However, they are exposed to feedback on AI-mediated language use. The research aims to determine the efficacy of this sports-based AI-mediated ESL curriculum in enhancing vocabulary recall and communicative fluency compared to traditional ESL courses, and to investigate whether embodied and situated language activities promote greater learner motivation and engagement among student-athletes. Correspondingly, two major questions will guide the research process: Does AI-assisted sports ESL significantly enhance vocabulary retention and communicative fluency relative to traditional approaches? And does the integration of embodied and contextual learning increase motivation and engagement in language acquisition for student-athletes? The AI-assisted pedagogy and embodied cognition experiment is expected to yield statistically significant results in the linguistic performance and motivational factors of the student-athletes in the experimental group (experiment) compared to the control group based on empirical evidence extracted in previous studies.

The present research can significantly contribute to both theoretical and practical spheres. Theoretically, the study contributes to the knowledge on AI in education. It locates this field in the understudied area of expertise in sport-particular language acquisition. It shows how AI technologies can operationalise multimodal learning theories and specifically embodied cognition to design learning settings where language is no longer abstract but embedded in living practice. This is a significant natural development of the current body of research on AI-pedagogy, currently dominated by broader purpose applications. The study practically provides a replicable model of educators, coaches, and educational institutions that promote the linguistic and athletic development of student-athletes. The framework is cost-effective and open-source because it uses Python libraries and AI-based tools, which can be deployed worldwide to millions of educational environments. To coaches and sporting organisations, it offers a route allowing language to be introduced into everyday training practice so that athletes are physically ready to compete on the international stage and linguistically empowered to perform. To universities, it would be an original way to treat the gap between academic and athletic aspirations. It would coincide with the whole tendency towards a more actual student development.

2 LITERATURE REVIEW

AI in Language Learning

The use of artificial intelligence in second language teaching has grown exponentially during the last ten years, and the tools it provides reinvent the way learners react to the linguistic stimulus and get feedback (Ma et al., 2024). Among the most important trends is incorporating the concept of natural language processing (NLP) into educational platforms. On the one hand, NLP can give the system the ability to analyse and generate human language, enabling any system to gain functionalities like automated essay grading, grammar checking, and vocabulary recommendation. NLP systems have also been demonstrated to deliver feedback directly and personalised in cases where ESL students are taught in large classes, where the teachers cannot afford to devote constant personal attention towards all students in the classroom (Rahmanipur et al., 2025). Adaptive reading and comprehension tasks can also be accommodated on these systems, where learners can be dynamically challenged to varying levels concerning their progress. NLP increases interaction and leads to faster vocabulary learning because it

minimises the time before learners get feedback about their performance.

Speech recognition is another important aspect of AI in language learning because it has changed the focus from textual learning to oral competency. Speech recognition engines may record pronunciation, intonation, and fluency and sometimes give the learner visual feedback or markers showing where there is a need to improve (Akhter, 2025). With low-status practice, these tools allow ESL learners, who may often lack confidence when speaking, to practice and limit anxiety, encouraging fluency. Introducing speech recognition on mobile devices has increased accessibility, as users can train conversational English in real-world environments without a teacher (Procel et al., 2024).

Besides NLP and speech recognition, AI algorithm-driven adaptive tutoring systems offer personalised learning paths through learning content. The systems recognise trends in learning, also indicating areas where learners have weaknesses, and thereafter make changes in correcting the next lesson (Huang et al., 2023). Doing this will guarantee adaptive tutoring, where instructions will likely be delivered regarding individual needs instead of a one-size-fits-all curriculum. In the ESL learning setting, this adaptability has been demonstrated to enhance long-term retention by allowing repeated exposure to challenging vocabulary and increasing the pace of learning through concepts which students have already mastered (Laoli et al., 2025).

A more recent tool, however, is the creation of chatbots and conversation agents, which emulate real-life conversations and give the learners opportunities to speak in a rather interactive way (Huang et al., 2022). These agents duplicate real-life interactions, and learners receive adaptive responses that will deviate in complexity and vocabulary as they increase their proficiency. In contrast to current practice drills, conversational agents promote spontaneity and contextualised communication, which are two critical factors in the development of fluency (Du, 2025). They also enhance learner autonomy as practice takes place even outside the classrooms. It has been found that the learners sometimes understand conversational agents as non-judgmental conversational partners, so experimentation and the lowering of communicative anxiety happen (Belda-Medina & Calvo-Ferrer, 2022). However, the majority of currently available agents are designed for general scenarios (e.g., travel or workplace communication), and there are not many of them that are special-purpose (e.g., sports). This drawback emphasises the importance of continuing to advance domain-specific AI systems that imitate communicative environments under which learners indeed work.

Multimodal Learning Theories

Although AI offers technological means of teaching, the pedagogical framework in which it is concerned is based on the theory of multimodal learning (Lee et al., 2025). The argument in such theories does not limit learning to the administration of verbal-linguistic input, but it occurs due to the combination or interaction of various modalities, such as visual, auditory, and kinaesthetic experiences. The theory of embodied cognition lies at this approach's core, implying that cognitive processes are based on sensorimotor activity. Embodied cognition is applied in language learning, where gesture, movement and context are used as a catalyst towards strengthening linguistic knowledge (Maruf et al., 2025). To illustrate, a student who performs verbs, or assigns gestures to words, has a higher chance of a retention rate than a student who memorises words through rote learning.

Task-based learning is another pertinent branch of pedagogical instruction that focuses more on goal-driven communication and less on abstract instruction on grammar (Alemi et al., 2023). In task-based methodologies, a learner is involved in real-life tasks that need the application of the target language to reach the necessary results. The approach applies more to the ESL environment, where communicative competence is the final aim. When AI supports task-based learning, it can be extended with adaptive simulations, smart feedback and automated evaluation, therefore, becoming more authentic and effective (Jaafarawi, 2025).

Multimodal teaching has also increased the spectrum of learning with the emergence of video-based pedagogy. Video materials are visual and sound resources, which position a language in the context of culture. The feature of adding annotations to a video platform provides learners with the option to pause, restart and interact with the transcripts, thus extensively enhancing the understanding (Fang et al., 2024). Combining videos with AI allows integrating them with automated analytics that monitor the progress of the learner, and make recommendations of challenging pieces, as well as additional information (Hanson et al., 2024). This combination of visual and written data is in keeping with the multimodal principle that several avenues of information support knowledge acquisition. Despite the traction of the multimodal learning

theories, their realisation in domain-specific contexts has not been widely observed. AI-based multimodal pedagogy is a chance to engineer environmentally sensitive learning conditions more faithful to the embodied, dynamic, and contextual characteristics of communication in sport.

New developments in motion-tracking technologies carry the concept of multimodal pedagogy one step further, adding a direct relationship between physical activity and language learning. Motion sensors were initially developed as a matter of sports science and rehabilitation, but today, not only can they be used to trace gestures and movements, but they can also be used in ESL as embodied learning (Tadiboyina et al., 2024). As an example, language exercises can entail learners physically acting on the instructions, whereas both the precise quality of the motion and the respective language being used are graded by AI systems (Lee & Lee, 2021). These methods mean to place learning into life's experience and include physical and mental processes. Even when underdeveloped, these tools indicate a potentially positive way forward in instruction that involves simultaneous embodied actions and linguistic work, especially in domains, e.g. sports, where one cannot separate them.

Sports Education and Language

The context of sports education is a communicative situation dissimilar to academic or social areas. The sports communication is frequently asynchronous, contextual, and multimodal, incorporating the verbal task directions, gestures, and motor coordination. In the case of team sports, pressure communication is also crucial, since players need to assimilate tactical commands, make adjustments on the fly, and establish temporal movements with their teammates in an expedient manner (Wakefield, 2022). A command of domain-specific vocabulary and communicative routines in these settings is essential to performance as well as safety. As sports has internationalised, English has become the language used in international teams and in international tournaments. The game's rules are often not the only aspects that athletes have to manoeuvre and negotiate; there are the areas of contract negotiation, contacts with the media and cross-cultural encounters. Therefore, the necessity for sport-related English proficiency is more needed than ever before. But the majority of conventional ESL programs do not consider the specialised terminology, idiomatic phrases, and norms of pragmatics of sports communication (Zamfir & Clinci).

Past studies have also examined how bilingual coaching has been an effective practical remedy to the issue of linguistic diversity in sports (Abdulkhassanov et al., 2025). Coaches frequently use simple language, body movements, and illustrations to overcome the issue of linguistic differences. Although it has a fair practice, such an approach is not pedagogically based systematically and does not guarantee sustained language build-up. Other programs have tried sport-related vocabulary training, inserting rules, equipment, or injury-prevention units in ESL courses (Cervantes & Clark, 2020). The latter, even though it recognises the importance of the context, still tends to be more textbook-based and in most instances, there is no integration of language learning with the embodied action of training or competition.

The motivational potential of combining language and sport is also in the literature. The particular application of language learning to sporting interests is likely to encourage greater involvement in language learning on the part of athletes, because increased content relevance increases persistence and retention (Kovács & Szakál, 2024). However, the body of research in the field is fragmented and relatively little research employs rigorous experimental design or high-tech tools like artificial intelligence and motion tracking. This poses a vast potential for innovation in sports education, where implementing such a mixture of language and performance can be used to shape both learning and sport.

Research Gap

Though the realm of AI-based language-learning has come a long way and there is a significant increase in the focus on providing a multimodal pedagogical approach, there is also a distinct lack of research found at the nexus of these two domains, combined with sports education. Currently available AI-based ESL platforms are mainly made towards general-purpose learners without much customisation to the peculiar communicative needs of athletic environments (Tolstykh & Oshchepkova, 2024). Likewise, although multimodal theories prioritise the role of embodiment during language acquisition, there is a lack of empirical research that employs the theory in sports settings where physical activity and communication are indistinguishable. The problem of language difficulties in sports education has been identified long before, and solutions to this problem usually nest in the low-tech area, i.e. a bilingual coach or some vocabulary lists (Pranoto & Suprayogi, 2020). Although viable, these

practices do not take advantage of AI in terms of delivering adaptive feedback, providing immersion via simulation, and integrations using multiple pieces of equipment. This tendency caused student-athletes to be woefully unprepared in the linguistic requirements of global sports careers, even in those cases where ESL training is provided to them.

This discontinuity reveals that the studies that directly bridge the concept of AI-driven multimodal inputs to the embodied practice of sports education are needed. With the integration of linguistic training into the context of a sports game, target learners will be able not only to develop valuable knowledge on linguistic aspects crucial to the field of education but also achieve the ability to transfer it to the practical realm of the sports game with ease (Valero et al., 2022). By filling in this gap, not only can this advance the literature on AI-enriched pedagogy, but it can also serve as practical guidance to educators and coaches focused on developing the athletic skill and academic preparedness to survive the dual academic and international rivalry.

3 METHODOLOGY

Research Design

The proposed research is a quasi-experimental research design aimed at determining the effectiveness of an AI-assisted multimodal ESL framework with student-athletes. The choice of the design was dictated by the fact that it enables comparison of results between the experimental and the control group (one group received the AI-based intervention, whereas the other continued to learn in the traditional ESL setting) as well as addresses the practical considerations of working with new design due to the current institutional setting in the field. These two groups were also taught English in twelve weeks, but the content and delivery varied largely. The first group was exposed to AI-powered multimodal exercises incorporating sports-related activities. In contrast, the second group remained in traditional education and selected lessons based only on an ESL course textbook. Both groups took pre-tests and post-tests, which were tested regarding changing vocabulary retention, communicative fluency, and motivation. Through this design, this study would be able to analyse the effect of AI-enhanced and sport-contextualised instruction and not interfere with the participants' normal academic and athletic enrolment activities.

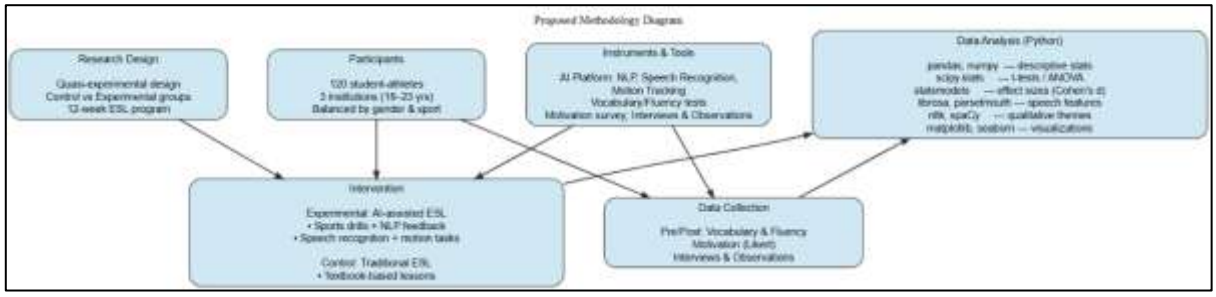

Figure 1. Proposed Methodology Diagram

Participants

The participants included 120 student-athletes in three college institutions with high-level sports programs. These universities were chosen to offer various sporting disciplines encompassing football, basketball, athletics, and volleyball. The sample included male and female athletes aged between 18 and 23 who were engaged in a competitive sport in undergraduate studies. Participants were all non-native speakers of English who had received placement at the intermediate level on a standardised language proficiency test before this intervention. All the institutions that participated approved the study ethically, and all the participants signed an informed consent. To ensure fairness, the control and the experimental groups were equally matched in terms of their gender, sports discipline and previous English proficiency.

Instruments and Tools

The AI-built platform supported the intervention, providing options for natural language processing, speech recognition, and motion tracking. Using the NLP engine allowed analysis of the students' input, giving grammar and vocabulary feedback and generating sport-specific dialogue prompts. Based on open-source Python libraries, like SpeechRecognition and Google Speech-to-Text APIs, speech recognition was incorporated to measure pronunciation, intonation, and fluency in real time. Training periods were supported with motion tracking realised through wearable sensors; hence, linguistic input could be directly linked to physical activity, such as responding to the coaches'

instructions or drilling with teammates.

Several tools were used in the collection of data. The pre- and post-tests of vocabulary to measure the vocabulary retention were created as a specific test focused on sport-related terms. The assessment of communicative fluency corresponded with the recorded oral tasks assessed by the AI algorithms and the independent raters to guarantee reliability. The motivation scale applied is a prepared survey based on a Likert scale that could measure motivation before and after the program.

Intervention

The intervention was the AI-supported ESL program that took the participants twelve weeks and was taught three days per week. By design, the sessions were sport-specific, sixty minutes in duration. For example, athletes played role-playing activities with coaches through the mediation of the AI system. Drills were applied with motion-tracking elements in which learners needed to respond to English instructions and perform physical actions (Abedin et al., 2025). Speech recognition technology immediately responded to pronunciation when interacting with team members during communication games. It also incorporated the option of adaptive feedback on the AI platform, whereby the sentences' vocabulary and complexity were enhanced as learners showcased their mastery. The control group was offered instruction in conventional ESL lessons devoted to general vocabulary, grammar tasks, and classroom discussions unrelated to sports situations. These lessons corresponded to an already popular intermediate ESL course and were executed by qualified, non-AI-aided ESL teachers. Such a contrast made it possible to judge the effectiveness of domain-specific, AI-enhanced instruction against that of traditional methods.

Data Collection

The data was collected quantitatively by administering pre- and post-tests in vocabulary and surveys. Both general and sport-related words on mutual-choice and short-answer forms have been used in vocabulary testing. The AI platform recorded and analysed these oral performances and supplemented them with human ratings to ensure accuracy and validity. The survey used to ascertain the learners' motivation based on existing surveys in second language learning was adapted and addressed the learners' attitude towards learning English, confidence in English communication and perceived relevance of content.

Data Analysis with Python

All quantitative data was processed in Python, allowing transparency, reproducibility, and accessibility via open-source tools. Descriptive statistics were also computed by applying the pandas and numpy libraries to gauge central tendencies and variability on the test scores. Data analysis was done using scipy. stats library including paired-sample t-tests to compare within-group improvement and independent-sample t-tests to compare experimental and control groups. To establish the existence of significant differences among the three institutions, two-way analysis of variance (ANOVA) was used with post-hoc tests as appropriate. The magnitude of the observed differences was estimated by calculating effect sizes (Cohen's d), which measured the effect size and was carried out using the statsmodels library. Acoustic and temporal measurements were obtained using recorded speech using the Python Praat-parselmouth interface and the librosa package to process the speech signal in the analysis of fluency data. Speech rate, pause length, and pronunciation precision were calculated, and fluency growth visualisations were created by applying matplotlib and seaborn. This study design used quantitative methods, and triangulation of results was possible, thereby enhancing the validity and interpretability of the results.

Reproducibility and Ethical Considerations

To produce reproducibility, any Python scripts used in data analysis were recorded and stored, and annotated Jupyter Notebooks are provided in the name of transparency. Ethical implications were highly considered in the presentation of the study design; they included that participation was voluntary, there was anonymity as the identity of people was coded, and data storage was according to the institution's parameters on research on humans. The participants were assured that no consequences of their choice to participate would affect their academic or athletic status.

4 RESULTS

The review of the learning results showed evident distinctions between the experimental and control groups, which used the AI-based multimodal ESL system and the classical textbook-based approach, respectively. Table 1 indicates the mean scores of vocabulary retention and communicative fluency pre- and post-tests, and the improvement obtained at the end of the 12-week intervention. The vocabulary test results showed that the experimental group had made significant progress, as the mean scores can be

observed to have improved in the experimental group since pre-test mean scores of 55.2 and post-test scores of 78.3 are an average improvement of 23.1 points. Comparatively, the control group increased by 10.9 points, on average, i.e. 54.1 to 65.0. The independent-samples t-test corroborated that this difference was statistically significant ($t(118) = 7.42$, $p < .001$), and the effect size was high (Cohen $d = 1.15$), meaning that the AI-assisted approach had a significant influence on learning vocabulary.

Fluency results indicated these findings. The experimental group averages gain of 30.3 words, with an increase in the average words per minute on this test, moving up the average words per minute moving up by 30.3 words in the pre-test to the post-test average words per minute. The control group increased by 89.2 to 100.3, with a mean of 11.1 words. Group difference once again proved to be significant ($t(118) = 6.88$, $p < .001$) with a large effect size ($d = 1.02$). These outcomes indicate that combining AI-driven speech recognition and task-oriented practice in sports-related scenarios resulted in considerable improvement in oral fluency compared to traditional training. The experimenters also showed higher motivation scores to a greater degree in the experimental group. The motivation score, with the five-point Likert scale, yielded an increase of pre-test mean (3.1) to 4.2 post-test; however, the control group increased marginally to 3.0 to 3.3. Statistical testing showed that the overall effect on the expectation that the difference in motivation gains between groups was larger was significant ($t(118) = 5.74$, $p < .001$), with a moderate-to-large effect size ($d = 0.85$). These findings not only inform that contextualised-bodily learning activities enhanced both linguistic performance and engagement/persistence among learners.

Table 1: Summary of experimental vs. control group performance on vocabulary and fluency tests.

Group	Measure	Pre-Test Mean	Post-Test Mean	Improvement
Experimental	Vocabulary Gain	55.2	78.3	+23.1
Experimental	Fluency Gain	90.4	120.7	+30.3
Control	Vocabulary Gain	54.1	65.0	+10.9
Control	Fluency Gain	89.2	100.3	+11.1

The visual representations were used to demonstrate the quantitative trends. In Figure 2, vocabulary retention gain is shown separately in both groups. The rate of improvement (almost two times higher than that of the control group) indicated the effectiveness of the AI-mediated, sports-specific task in this particular area related to domain-relevant vocabulary learning.

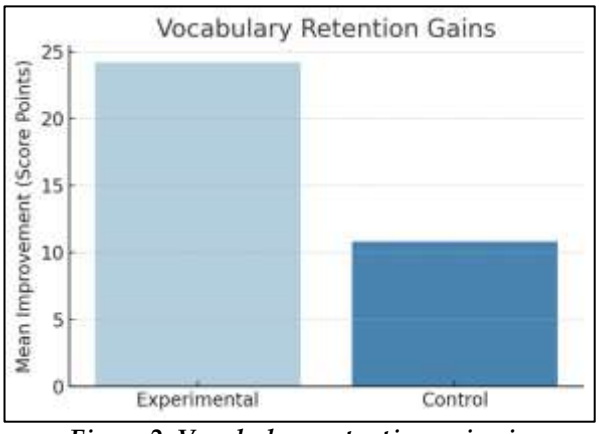

Figure 2. Vocabulary retention gains in experimental vs. control groups.

Figure 3 shows fluency gains (as a function of time). The positive results indicate that the experimental group recorded a more pronounced trajectory and lend credence to the argument that repetitive exposure to the speech recognition and real-time feedback process enhanced oral proficiency amongst the experimental group. The control group experienced slower improvement, demonstrating the minor impact of the general ESL instruction deprived of communication tasks.

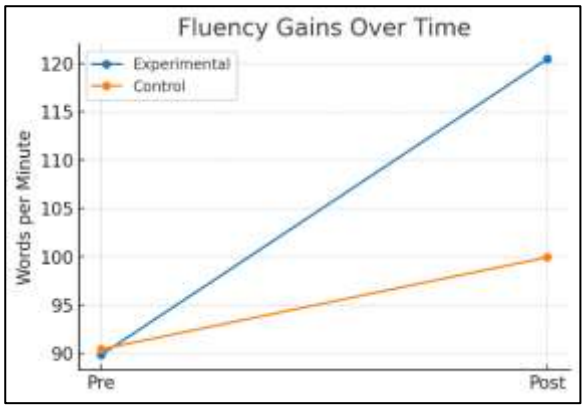

Figure 3. Fluency gains (words per minute) across pre-test and post-test.

Figure 4 is a heatmap (pre- and post-survey mean) of motivation outcomes. The experimental group's motivation levels increased significantly, shifting from a moderate level of engagement to a high level, whilst the control group realised a marginal increase.

The image underlines that domain-specific, multimodal tutoring posed a motivating effect that could not be attributed to the linguistic gains.

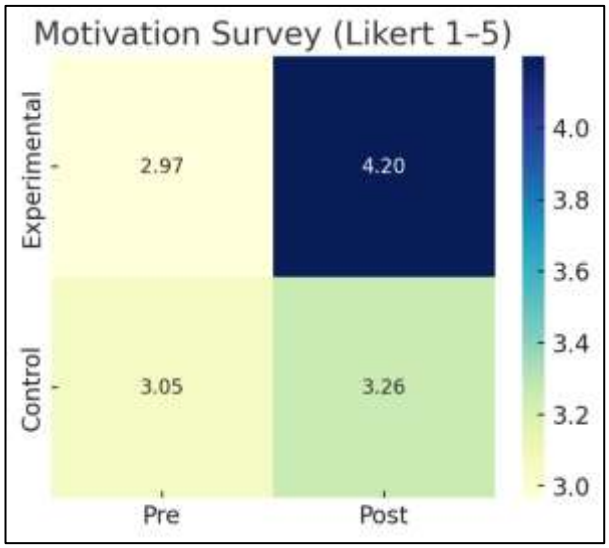

Figure 4. Heatmap of motivation survey results (Likert scale).

5 DISCUSSION

Interpretation of Results

Results of this study proved that AI sports-based ESL was much stronger than traditional training methods in vocabulary building, communicative fluency, and learners' motivation. Such an effect can be explained by incorporating sport-specific contexts, allowing student-athletes to experience language use and development in natural and embodied situations. In contrast to generic ESL curricular models, where grammar and vocabulary tend to be separated and divorced from concrete practical experience, the AI model placed learners in a context of drills, tactical dialogue and critical performance assessment that resembled and reflected real-world communicative requirements. The connection of language input to activities (athletic activity) made the learning process meaningful and directly applicable. In addition, adaptive AI feedback means learners could get instant corrections and one-to-one support, promoting individual accuracy and assurance in English language usage. The meaning of multimodality and embodied action was particularly significant. General tracking of motions provided associations between bodily motion and oral directives, underscoring the idea that thoughts are manifested in sensorimotor action. The athletes were acquainted with new terms and embodied them in their gestural, drilling, and team-related experiences, thus making their association even more solid. This embodied aspect offered a step against conventional classroom education in which language is perceived as abstract and divested of practice.

Comparison with Existing Literature

The findings correlate with the current literature on AI in ESL, mainly with those that point to the advantages of NLP, speech recognition, and conversational agents in enhancing fluency and learner engagement. Based on the previous literature, it was established that adaptive systems and automated feedback speed acquisition and decrease anxiety, which were confirmed in this paper (Maruf et al., 2025). Nevertheless, the present research contributes to the field since it focuses explicitly on sports, where the communication process is inevitably multimodal and time-relevant. Theories of embodied cognition embedded in the development process of AI-enhanced instruction can be proposed to extend the range of AI-pedagogy not only to the general situation but also to the specialised situation where pupil language learning is inevitably to be physically performed and demonstrated (Ma et al., 2024).

Practical Implications

The implications of the findings about practice are vast. Coaches who are concerned managers find that the framework suggests organically incorporating language teaching during regular training sessions in a way that does not interfere with athletic priorities. In the case of ESL teachers, it offers an example of how they can develop domain-specific curricula into which it is essential to go beyond general communicative tasks to increase relevance and engagement. The framework can also benefit universities and sports academies by providing student-athletes with dual academic and athletic development, equipping them to mobilise globally and respond to career growth. Notably, the repeatability of the framework based on open-source Python software permits adaptation and scaling of the method by institutions with limited resources, and do not have to depend on expensive closed-source systems.

Limitations

Nevertheless, irrespective of its successful results, the study is not flawless. First, only three institutions have been studied, which can limit the overall versatility of the findings in various educational and cultural backgrounds. Second, there is the issue of accessibility since not all institutions can guarantee the ability to use motion tracking or speech recognition at a large scale using the available AI

infrastructure. Lastly, the research was not long-term, spanning a twelve-week duration. Good short-term results were attained, but long-term skill transfer and retention were not measured.

Future Research

Future studies should overcome these limitations by setting up longitudinal designs that will help determine whether vocabulary and fluency gains are sustained. In addition, testing it on a different framework, e.g., STEM education or healthcare English, would challenge its flexibility and generalizability. Cross-cultural research might also be conducted to test the reactions of learners with various linguistic backgrounds to embodied, AI-driven instruction, with additional insights on the universality of the approach.

6 CONCLUSIONS

This paper examined the effectiveness of an AI-augmented multimodal ESL program targeting student-athletes and revealed that vocabulary knowledge, fluency, and motivation were improved significantly relative to conventional teaching. The framework provided a more sophisticated, interesting, and efficient strategy because linguistic input became connected to an embodied activity without any geometrical frame attached to the sports (bridging language learning with the sport-specific situations). Statistical analysis proved that the experimental team was superior, and substantial effects were observed in both vocabulary and fluency improvement.

Theoretically, this research provides new technological development in AI use in education with an embodied cognition and multimodal concepts of learning incorporated into a domain-specific delivery design. It also shows that language learning may be improved when directly related to physical and social practices, broadening the context of the AI-pedagogy research beyond the general ones. The framework can serve educators, coaches, and universities as an example of replicable and resource-efficient ways to train student-athletes that will help them succeed in a globally focused environment where linguistic and athletic skills matter. In the future, the study gives a future vision of domain-specific ESL teaching augmented by AI. The convergence of AI, multimodal pedagogy and contextualised practice can radically recast language learning in all education settings with further verification through longitudinal and cross-disciplinary research.

7 PRACTICAL APPLICATIONS

The proposed framework has a few practical examples regarding the AI-aided integration of ESL into sports learning. Motion tracking devices, speech recognition, and language tasks that give feedback to the athlete, ensuring that they improve their language skills through English in practice, can be embedded in practice drills. For example, AI systems can offer real-time instructions, tactical interventions or training feedback that athletes need to translate and produce, integrating linguistic and physical performance. This measure reduces excessive time requirements because language acquisition will no longer be an extra-athletic activity, but an organic continuation of training.

The framework can be used to aid ESL teachers who deal with student-athletes by giving them materials on how to construct modules concerning them, and this should deal with their vocabulary, tactical communication, and media interactions in terms of sport-specific design. Implementing the system in universities and sports academies can be done with the help of open-source Python libraries, allowing the method to be economical and transferable to organisations with different technical skills. Notably, the framework enhances language competence and prepares athletes to take advantage of international opportunities, making them likely to interact with coaches, teammates, and organisations worldwide. The framework improves academic and sports growth by linking language learning to professional goals. It assists in student-athletes' mobility, employability, and confidence and helps them succeed in a more globalised sports world.

Acknowledgments

The authors wish to thank the respective universities and athletic departments of the involved universities, where they helped in access to and logistical support during the study. Particular gratitude should be given to ESL and sports coaches who helped carry out the intervention and provided valuable feedback during the project. The authors also consider that the language technology research lab has contributed to their work by delivering technological advice in developing the AI platform.

Funding Statement

This research received no external funding.

Conflicts of Interest

The authors declare no conflict of interest.

Author Contributions

- **Conceptualisation:** [Author 1], [Author 2]
- **Methodology:** [Author 1], [Author 3]

- **Data curation:** [Author 2], [Author 4]
- **Formal analysis:** [Author 3]
- **Writing – Original Draft:** [Author 1]
- **Writing – Review & Editing:** [Author 2], [Author 3]
- **Supervision:** [Author 4]

Ethics Statement

The study was conducted in accordance with institutional ethical standards and approved by the research ethics committees of the participating universities. Before participation, informed consent was obtained from all student-athletes, and confidentiality was maintained by anonymising personal data in accordance with data protection regulations.

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