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Article

Integrating gesture and posture analysis in enhancing English language teaching effectiveness

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Abstract: Non-verbal communication, particularly gestures and posture, is vital in enhancing student engagement, comprehension, and retention in language learning. This study investigates the impact of integrating deliberate gestures and posture into English language teaching, focusing on student learning outcomes. A controlled experiment was conducted with 58 participants (8 teachers and 50 students) divided into Experimental Groups (EG) and Control Groups (CG). Teachers in the EG received training on the effective use of iconic, deictic, metaphoric, and beat gestures and posture awareness techniques, while the CG followed traditional teaching practices. Data were collected through pre-and post-tests, student surveys, classroom observations, and retention assessments. The results demonstrated significant improvements in the EG compared to the CG across all measures. Comprehension scores in the EG increased by 6.62 points, compared to 2.96 points in the CG (T-statistic = 3.27, P-value = 0.002). Student engagement levels were also higher in the EG, with more frequent participation, higher motivation, and a more substantial influence of gestures and posture on learning (F-statistic for engagement = 18.27, P-value = 0.002). Additionally, retention of language concepts two weeks after the intervention was significantly higher in the EG, with an 8.50% improvement over the CG (Cohen's d = 2.01, large effect size). Regression analysis further confirmed that gesture frequency and type strongly predicted comprehension, engagement, and retention improvements.

Keywords: gesture frequency; posture; language learning; regression analysis; biomechanical patterns

1. Introduction

Effective language teaching involves more than just verbal instruction. Non-verbal communication, particularly gestures and posture, is critical in facilitating classroom learning, engagement, and comprehension [1,2]. Gestures—movements of the hands, arms, and body accompanying speech—reinforce spoken content visually, making abstract concepts more tangible and easier to understand [3–5]. Similarly, teachers' posture and movement within the classroom can significantly influence student engagement and classroom dynamics [6,7]. Despite the acknowledged importance of these non-verbal cues, the systematic study of their impact on language learning, particularly in English as a Second Language (ESL) contexts, remains relatively underexplored [8–10].

In recent years, research has increasingly highlighted the connection between gesture use and improved student outcomes [11,12]. Gestures have been shown to facilitate the retention of information, increase student engagement, and improve comprehension of complex language concepts [13,14]. Iconic, metaphoric, and deictic gestures, in particular, provide students with visual cues that supplement and clarify

spoken language, offering an additional layer of meaning that supports both immediate understanding and long-term recall [15,16].

Furthermore, the role of teacher posture—whether open and expansive or closed and static—can also shape student perceptions and engagement in the learning process [17,18]. An open, dynamic posture conveys confidence and accessibility, encouraging student participation and fostering a more interactive classroom environment [19]. Conversely, a teacher who remains static or exhibits closed postures may inadvertently signal disengagement, reducing student motivation and participation [20].

While previous studies have primarily focused on the cognitive benefits of gestures in language learning, fewer have examined how gestures and posture impact student outcomes. This study aims to fill this gap by investigating the effects of an integrated approach to non-verbal communication on student comprehension, engagement, and retention in the context of English language teaching. Specifically, we seek to determine whether teachers' deliberate use of gestures and posture can enhance teaching effectiveness and lead to measurable improvements in student learning. The primary objective of this research is to assess the impact of gestures and posture on three key aspects of student learning:

Comprehension: Does integrating gestures and posture improve students' understanding of English language concepts during lessons?

Engagement: How do gesture and posture interventions influence student participation, motivation, and interaction in the classroom?

Retention: Are students better able to retain and recall language concepts over time when teachers use gestures and posture more deliberately?

This study is significant because it comprehensively evaluates how non-verbal communication enhances language instruction, going beyond traditional teaching methods that rely primarily on verbal explanations. By integrating cognitive and pedagogical research findings, this study provides valuable visions for educators aiming to improve language teaching effectiveness through non-verbal strategies. The results of this research will contribute to a deeper understanding of the practical applications of gestures and posture in ESL teaching and may lead to more effective, student-centered teaching practices in language education.

The rest of the paper is organized as follows: section 2 presents the theoretical framework, section 3 presents the methodology, section 4 presents the results and analysis, and section 5 presents the conclusion.

2. Theoretical framework

The theoretical framework for integrating gesture and posture analysis in enhancing English language teaching effectiveness draws from established communication theories and educational psychology [21,22]. This section explores key theoretical perspectives that underpin the use of non-verbal communication, particularly gestures and posture, in language learning and their potential benefits in classroom settings.

2.1. Theories of communication and language learning

Communication and language learning theories emphasize the importance of verbal and non-verbal elements in successful interaction and knowledge transfer. One foundational theory is Vygotsky's *Social Development Theory* (**Figure 1**), which highlights the role of social interaction in cognitive development. Vygotsky argued that learning is a socially mediated activity, and teachers, as more knowledgeable others, can scaffold student learning through both spoken language and non-verbal cues like gestures. In language education, gestures are cognitive tools that make abstract linguistic concepts more accessible, allowing learners to internalize complex ideas through physical demonstration [23–25].

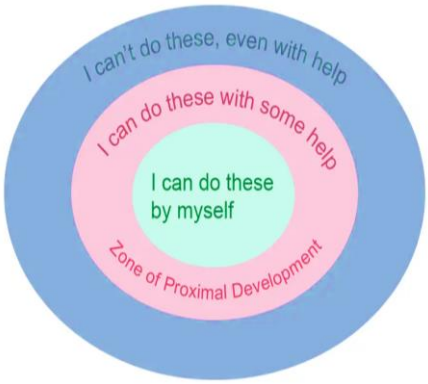

Figure 1. Vygotsky's social development theory.

Another fundamental framework is *McNeill's Gesture Theory* (**Figure 2**), which suggests that gestures are not merely supplementary to speech but an integral part of the communicative process. McNeill identified four types of gestures—iconic, metaphoric, deictic, and beat gestures—each playing a different role in conveying meaning. Iconic gestures, for example, directly represent speech content, making them particularly useful in language instruction, where abstract concepts may be too complex to explain verbally alone. Deictic gestures, such as pointing, help direct learners' attention to relevant language elements and enhance understanding [26–28].

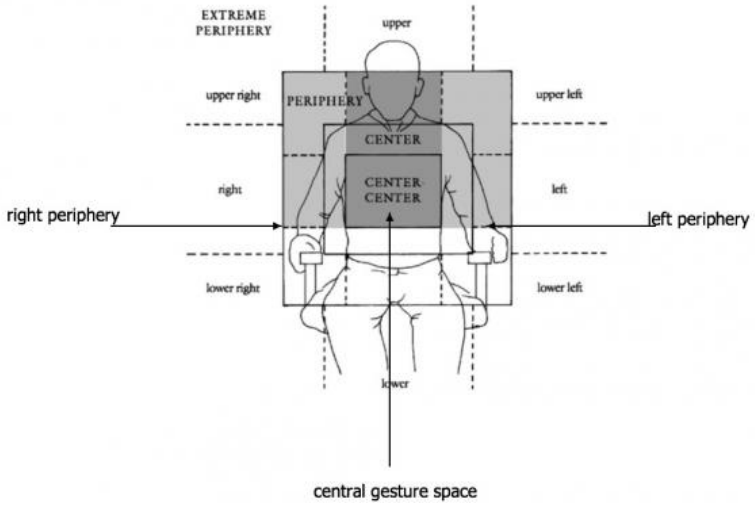

Figure 2. McNeill's gesture theory.

2.2. Gesture and cognitive load reduction

Gestures play a pivotal role in reducing cognitive load during language learning. Cognitive Load Theory (CLT) (**Figure 3**) posits that learning efficiency depends on how much mental effort is required to process new information. By visually representing concepts, gestures help reduce the cognitive demands on learners by distributing the processing load across both visual and auditory channels [29,30]. This is particularly important in language learning, where students may struggle to process large amounts of verbal information alone.

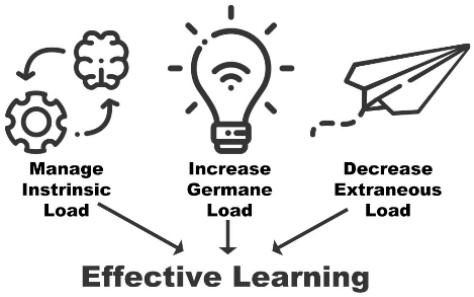

Figure 3. Cognitive load theory.

Research has shown that gestures can alleviate extraneous cognitive load by breaking complex language structures into more manageable visual representations. For example, iconic gestures that mimic the shape or movement of an object provide learners with visual anchors that aid in memory retention and comprehension [31–33]. Studies have also demonstrated that learners retain information better when accompanied by relevant gestures, as these non-verbal cues help encode information in both linguistic and motor memory, leading to deeper cognitive processing.

2.3. Posture and classroom presence.

Posture is another critical aspect of non-verbal communication that influences teacher-student interactions and learning effectiveness. Teachers' posture conveys authority, openness, and engagement, which can affect student motivation and participation. According to *Mehrabian's Communication Model*, body language—including posture (**Figure 4**)—constitutes a significant portion of how messages are interpreted, often more than spoken words. A teacher's posture in the classroom can signal confidence and control, creating a learning environment where students feel supported and encouraged to engage.

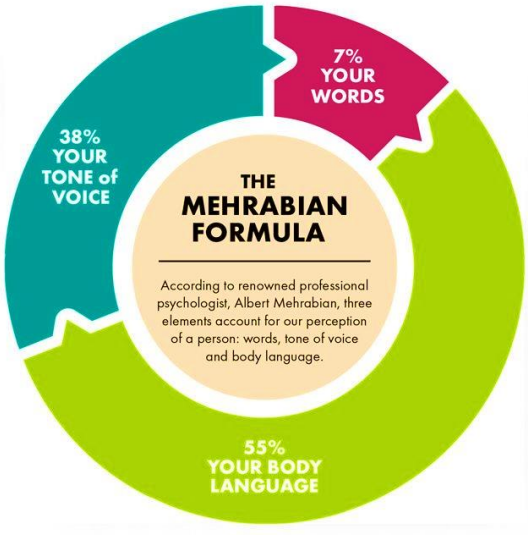

Figure 4. Mehrabian's communication model.

Posture also plays a role in classroom presence, defined as the teacher's ability to command attention and maintain student focus. Open, expansive postures communicate approachability and enthusiasm, making teachers more relatable and encouraging student interaction. Conversely, closed or defensive postures may inadvertently convey disinterest or frustration, potentially discouraging student participation. Moreover, maintaining an upright and stable posture can help teachers physically reinforce key language concepts through gestures, thereby creating a more dynamic and interactive learning experience.

3. Study design

3.1. Participants

The study was conducted in China and involved 58 participants, including 8 English language teachers and 50 students. The participants were selected from two middle schools and one high school located in Beijing and Shanghai, ensuring a representative sample of urban and suburban educational environments.

i) Teachers: The 8 participating teachers were all experienced English language instructors with a range of 5 to 18 years of teaching experience. Their average age was 38, with 5 female and 3 male teachers. All the teachers held at least a bachelor's degree in English or Education, with 3 of them having completed a master's degree in Teaching English as a Foreign Language (TEFL). The teachers were selected based on their involvement in regular English language teaching in grades 7 through 12. This range of experience allowed for an exploration of how different levels of expertise in using gestures and posture might affect teaching effectiveness.

ii) Students: The 50 participants were aged between 13 and 17 years, with an average age of 15.3 years. The cohort comprised 26 female and 24 male students, ensuring a balanced gender distribution. The students were enrolled in grades 7 through 12, representing a diverse range of English language proficiency levels. Their proficiency was assessed using the Common European Framework of

Reference for Languages (CEFR), with 15 students classified as A2 (elementary level), 22 students at B1 (intermediate level), and 13 students at B2 (upper intermediate level). This diversity in language skills allowed the study to assess the impact of gesture and posture across different learner capabilities.

In terms of educational background, the students all had consistent exposure to English language instruction, averaging 7 years of English language education. Most students received instruction within the classroom setting, with some (12 students) reporting additional support through private tutoring or language exchange programs. Including students from various backgrounds, they were ensured that the study could account for differences in prior exposure to English and the potential impact of external language learning environments.

3.2. Methodology

This section outlines the methods used to collect and analyze data regarding the impact of gesture and posture on the effectiveness of English language teaching in the classroom. A mixed-methods approach was employed, combining qualitative and quantitative techniques to ensure a comprehensive analysis. The primary data collection methods included gesture and posture analysis tools, classroom observations, and surveys distributed to students and teachers.

3.2.1. Gesture and posture analysis tools

Motion-capture technology and video recording were utilized to analyze gestures and posture in the classroom. Each classroom session was recorded using two high-definition cameras to capture the teacher's complete body movements and the student-teacher interactions from different angles. A wearable motion capture system was also employed to track the teachers' hand and arm movements in real-time. This technology allowed for the precise tracking of various gesture types, including iconic, metaphoric, deictic, and beat gestures, as well as changes in posture during the lessons.

A combination of video recordings and motion analysis software was used for the posture analysis. This software detected the teacher's stance, body alignment, and movement patterns, helping to identify key posture indicators such as openness, stability, and movement range. The software also recorded any shifts in body posture during critical teaching moments, allowing the researchers to link posture changes with specific language teaching tasks.

3.2.2. Classroom observations

In addition to the technological tools, classroom observations were conducted to provide qualitative insights into the dynamics between teachers and students during lessons. The research team observed 24 English language classes for 8 weeks, with 3 classes per week for each teacher. The observations focused on several key aspects: the frequency and type of gestures used by teachers, the teachers' posture and movement within the classroom, and the student's reactions and engagement levels in response to these non-verbal cues.

During each session, an observation checklist was used to systematically document occurrences of different gesture types, posture shifts, and their alignment with lesson content. Observers also recorded student engagement, noting when

gestures or posture changes increased or decreased student participation, understanding, or attention.

3.2.3. Surveys

To complement the observational data, surveys were distributed to students and teachers to gather their perceptions of how gestures and posture influenced learning and teaching. The student survey included questions on how gestures helped them understand new vocabulary, grammar structures, and overall lesson content. Students were asked to rate on a Likert scale (1 to 5) how effective they found their teacher's use of hand movements, pointing gestures, and body positioning in aiding their comprehension and retention of English language concepts.

Teachers were also surveyed to gather their perspectives on using non-verbal communication in the classroom. The teacher survey included questions on their awareness of gestures and posture during teaching, how they believed these elements affected student engagement, and whether they had received formal training in using gestures and posture as part of their teaching techniques.

3.3. Classroom setup

The classroom setup was carefully designed to facilitate the observation and recording of teaching sessions, ensuring that physical and digital tools could be seamlessly integrated into the regular learning environment without disrupting the natural flow of lessons. The setup aimed to capture the teachers' gestures, posture, and the student's responses in a method that allowed for comprehensive data collection while maintaining an authentic classroom atmosphere.

3.3.1. Physical setup

Each classroom was equipped with strategically placed equipment to capture all relevant aspects of the teaching sessions. Two high-definition video cameras were installed: one positioned at the front of the room, capturing the teacher's movements and gestures in full view, and the other at the back, offering a wide-angle view of the entire classroom, including student reactions and interactions. The placement of the cameras ensured minimal obstruction, allowing students and teachers to engage naturally during the lessons.

In addition to the cameras, wearable motion sensors were used to track the teachers' arm and hand movements in greater detail. These lightweight sensors, worn on the wrists, were non-intrusive and did not interfere with the teacher's ability to conduct lessons as usual. These sensors provided precise data on the frequency and type of gestures, tracking hand positions and movements throughout the class. A third, smaller sensor was placed on the teachers' back to monitor posture changes and movement within the space.

The classroom seating arrangements were left unchanged to maintain the typical learning environment, but markers were placed on the floor to help with the motion tracking of the teacher's movements within the room. The lighting conditions were adjusted to ensure proper visibility for video recording, but care was taken to avoid creating an unnatural or overly technical atmosphere.

3.3.2. Digital setup

Digital tools were employed to process and analyze the captured data to complement the physical setup. The video footage from both cameras was synced and uploaded to a central server for further analysis. Motion capture software was used to analyze the teacher's gestures, identifying specific types of movements (iconic, deictic, metaphoric, and beat gestures) and tracking their frequency and timing throughout the lessons. This software also captured data on the teachers' posture, identifying moments of openness, stability, and movement dynamics.

In addition to video analysis, wearable sensors transmitted real-time data on gesture velocity, direction, and range of motion, which was then visualized using motion analysis software. The collected data was stored digitally and time-synced with the video recordings, allowing for a cohesive analysis of both gesture and posture concerning specific teaching moments.

A digital survey platform was also integrated into the classroom setup. Students were asked to complete surveys on tablet devices at the end of each observed session, ensuring their responses were collected immediately after the lesson to capture fresh impressions of the teaching methods. The digital survey platform allowed for efficient data collection and real-time processing of responses, providing immediate insights into student engagement and perceptions of the lessons.

3.3.3. Minimizing disruptions

The design of the classroom setup prioritized minimizing disruptions to the teaching process. All equipment, including cameras, sensors, and recording devices, was either discreetly placed or designed to be non-intrusive. Teachers were briefed on the equipment before the study began to ensure they felt comfortable and could conduct their lessons as usual. Similarly, students were informed about the study in advance and were reassured that the presence of the equipment would not significantly alter their regular class routine.

By carefully balancing the classroom setup's physical and digital elements, the study captured high-quality data on gesture and posture without compromising the authenticity of the teaching environment. This setup ensured that qualitative and quantitative data were collected effectively, providing a robust foundation for analyzing the impact of non-verbal communication on teaching effectiveness.

3.4. Variables measured

Several key variables were measured throughout the study to evaluate the impact of gesture and posture on English language teaching effectiveness. These variables captured quantitative and qualitative aspects of the teachers' non-verbal communication and how they influenced student engagement, comprehension, and overall learning outcomes. The primary variables include the frequency, types of gestures used, posture stability, and movement patterns during the lessons.

3.4.1. Frequency of gestures

The first key variable measured was the teacher's frequency of gestures during each teaching session. This variable was important in determining how often gestures were employed in the instructional process and whether a higher frequency correlated with improved student understanding and engagement. The number of gestures per

minute was calculated by reviewing the video footage and analyzing the data from the motion sensors worn by the teachers. This frequency was then compared across different teaching sessions and evaluated concerning specific teaching tasks, such as vocabulary explanations, grammar demonstrations, or concept reviews.

3.4.2. Types of gestures

The types of gestures used by the teachers were another critical variable in the study. Gestures were classified into four main categories based on McNeill's gesture theory:

Iconic gestures visually represent the content of the spoken language (e.g., a hand motion mimicking the shape of an object or a physical demonstration of an action).

Metaphoric gestures convey abstract concepts (e.g., using hand movements to represent growth, change, or relationships between concepts).

Deictic gestures involve pointing to direct attention to a specific object, area, or element of the lesson (e.g., pointing to a word on the board or a diagram in a textbook).

Beat gestures are simple rhythmic hand movements that align with the rhythm of speech but do not carry specific meaning beyond emphasizing certain points.

Each type of gesture was tracked during the lessons using video recordings and motion capture data, and the frequency of each type was analyzed to determine which gestures were most commonly used and how they contributed to the student's learning experiences.

3.4.3. Posture stability

Posture stability was a key variable related to how the teachers maintained their stance and body alignment during the lessons. Stability was measured in terms of the teacher's ability to maintain an open and consistent posture while teaching and their movements within the classroom. A stable posture is associated with conveying confidence and authority, which can impact students' perception of the teacher and their willingness to engage.

The motion capture sensors the teachers wore recorded data on body positioning, including the angle and alignment of the torso, legs, and arms. Postural shifts, such as leaning or slouching, were flagged, and the data was used to determine the overall stability of the teacher's posture during different phases of instruction. The posture data was analyzed with student engagement levels to identify any correlations between posture stability and student responses.

3.4.4. Movement patterns

Movement patterns within the classroom were also tracked as a key variable. This involved analyzing how the teachers moved around the classroom space, including their walking patterns, interactions with students, and proximity to the students while explaining key concepts. Movement patterns were vital because they affect classroom dynamics, including student attention and engagement. Teachers who moved purposefully and maintained a presence throughout the room were expected to create a more interactive and engaging learning environment.

Movement was tracked using the motion capture sensors and the floor markers placed in the classroom. The distance traveled by the teacher during each lesson and the amount of time spent in different areas of the room was recorded. This data helped

assess whether specific movement patterns, such as approaching students during explanations or moving between different teaching aids (e.g., whiteboard, projector), were linked to higher student interaction and comprehension levels.

3.4.5. Additional variables

In addition to the key variables mentioned above, other contextual factors were also measured, including the duration of specific teaching activities (e.g., explaining grammar rules and conducting group activities) and the student engagement levels recorded during these activities. This included tracking eye contact, student participation rates, and verbal responses to the teacher's non-verbal cues.

3.5. Data collection

The data collection process for the study involved systematic procedures to collect and analyze both gesture and posture data during live teaching sessions. Multiple data sources were utilized, including video recordings, motion capture technology, and qualitative observations, to ensure a comprehensive understanding of the role of gestures and posture in enhancing English language teaching effectiveness.

3.5.1. Video recordings

Video recordings were a primary tool to capture the full scope of non-verbal communication during the teaching sessions. Two high-definition cameras were placed strategically in each classroom: one at the front, facing the teacher, and another at the back to capture a wide-angle view of the entire classroom. These recordings provided a complete visual record of the teacher's gestures, posture, movement patterns, and student reactions and interactions.

Each lesson was recorded for 60 min, ensuring that various teaching methods and non-verbal cues could be observed. After the recording, the videos were reviewed by researchers who annotated key moments when gestures or posture shifts occurred, noting the type of gesture and the context in which it was used. This allowed for a detailed breakdown of how often and in what ways gestures and posture influenced the lesson flow and students' engagement.

3.5.2. Motion capture technology

In addition to video recordings, motion capture technology was used to precisely track the teachers' gestures and postural changes throughout each teaching session. Teachers were equipped with lightweight, wearable motion sensors on their wrists, arms, and upper back. These sensors collected real-time data on the teachers' hand movements, arm gestures, and overall body positioning, allowing for detailed analysis of the frequency and intensity of gestures used during the lesson.

The motion capture system provided quantitative data on the velocity, direction, and duration of gestures and how often the teacher shifted posture or moved across the classroom. This data was time-synced with the video recordings to ensure that the visual and sensor data could be analyzed together for a cohesive understanding of how gestures and posture interacted with different teaching strategies.

3.5.3. Classroom observations

Qualitative classroom observations were conducted simultaneously with the video recordings to provide additional context for interpreting the data. Trained

observers were present in the classroom during each session, using structured observation checklists to document key aspects of the teaching process, including the types of gestures used, the stability of the teacher's posture, and the overall movement patterns within the classroom.

Observers also recorded how students responded to these non-verbal cues, noting increased engagement, such as raising hands, asking questions, or participating in discussions. This qualitative data was important for understanding how gestures and posture influenced student behavior and classroom dynamics.

3.5.4. Surveys and teacher reflections

After each teaching session, teachers and students completed surveys designed to capture their perceptions of the role of gestures and posture in the lesson. The student survey included questions on how well they understood the lesson content, how engaged they felt, and whether the teacher's gestures and body movements helped clarify complex language concepts. Students rated these items on a Likert scale from 1 to 5, providing a subjective measure of how non-verbal cues affected their learning experience.

Teachers were also asked to reflect on their use of gestures and posture, sharing insights into whether they felt certain gestures helped explain key concepts or noticed a change in student engagement based on their non-verbal communication. These reflections were used to triangulate the data collected through video recordings and motion capture, offering a holistic view of how teachers perceived the effectiveness of their gestures and posture.

3.5.5. Data analysis

Once all the data was collected, a multi-step analysis process was conducted. Video recordings were analyzed using gesture classification software that identified and categorized the types of gestures (iconic, deictic, metaphoric, and beat gestures) and their frequency. The motion capture data was processed to quantify posture changes and movement patterns, providing precise measurements of hand movements and body shifts over time.

Both quantitative data from the motion sensors and qualitative data from the classroom observations and surveys were analyzed to identify correlations between specific non-verbal behaviors and student outcomes. For instance, the frequency of certain types of gestures (e.g., deictic gestures for pointing) was compared against student engagement levels, as captured through survey responses and classroom observations.

By integrating multiple data collection methods, the study provided a robust and comprehensive analysis of how gestures and posture impact teaching effectiveness, offering objective measurements and subjective experiences from the classroom.

3.6. Experimental design

The experimental design for this study was structured to investigate the impact of gestures and posture on English language teaching effectiveness through a controlled and comparative approach. A mixed-methods experimental framework involving quantitative and qualitative data collection methods was adopted. The

design included a comparative study between CG, EG, and pre-and post-intervention assessments to measure student comprehension, engagement, and retention changes.

3.6.1. Grouping of participants

The participants were divided into two groups: EG and CG. The EG consisted of 4 teachers and 25 students, while the CG included 4 teachers and 25 students, for 8 teachers and 50 students across both groups. EG and CG were matched in terms of student demographics, English proficiency levels, and class sizes to ensure a fair comparison. The students were randomly assigned to EG and CG, ensuring that both groups represented the overall population.

The key difference between the two groups was the intervention applied to the teachers in the EG. Teachers in the experimental group received specialized training in using gestures and posture as teaching tools. This training emphasized the effective integration of iconic, metaphoric, deictic, and beat gestures and posture awareness techniques designed to enhance classroom presence and student engagement. Teachers in the control group, on the other hand, continued their standard teaching practices without any specific focus on gestures or posture.

3.6.2. Intervention for the EG

The intervention for the EG was designed to enhance teachers' awareness and deliberate use of gestures and posture during their lessons. Teachers underwent a two-week training program, which included:

Workshops on gesture use: Teachers were introduced to the different types of gestures and how they can be employed to clarify abstract concepts, provide visual representations of vocabulary, and direct student attention.

Posture and classroom presence: This training component focused on maintaining open and stable postures to project confidence and create an engaging classroom environment. Teachers were also trained to strategically use movement around the classroom to maintain student focus and foster interaction.

Practice sessions: Teachers participated in mock teaching sessions, during which their gestures and posture were observed and refined based on feedback from trainers and peers.

Following the training, the teachers in the experimental group implemented these techniques in their regular English language lessons for 8 weeks.

3.6.3. Teaching sessions

EG and CG participated in the same number of teaching sessions, each lasting 60 min. Over the 8-week study period, each group experienced 24 teaching sessions (3 sessions per week). The teaching content and materials were standardized across EG and CG to eliminate any lesson difficulty or subject matter variability. The teachers in EG and CG followed the same curriculum, focusing on English language skills such as grammar, vocabulary, reading comprehension, and writing.

Data on teacher gestures, posture, and movement patterns were collected during these sessions through video recordings and motion capture technology, as described in the previous sections. Additionally, classroom observations, participation metrics, and short comprehension quizzes administered at the end of each lesson monitored student engagement and performance.

3.6.4. Pre- and post-intervention assessments

To evaluate the effectiveness of the intervention, EG and CG underwent pre- and post-intervention assessments. These assessments were designed to measure changes in student comprehension, retention, and engagement with the English language content.

Comprehension Tests: Before the study began, all students completed a baseline comprehension test covering vocabulary, grammar, and reading comprehension. The same test was administered at the end of the 8 weeks to measure any improvements in comprehension.

Engagement Surveys: Students completed surveys evaluating their engagement in the lessons at the start and end of the study. These surveys included questions about how well they understood the material, how motivated they felt during the lessons, and whether the teacher's gestures and posture helped them focus or understand certain concepts.

Retention Tests: To assess long-term retention, students in EG and CG were given a follow-up test two weeks after the study concluded. This test evaluated how much material covered during the lessons was retained over time.

3.6.5. Data analysis strategy

The data collected from EG and CG were analyzed to identify any significant differences in student performance, engagement, and retention between the EG and CG. The analysis focused on:

Comparison of Pre- and Post-Test Scores: A paired t-test was used to determine whether there were statistically significant improvements in student comprehension in the EG compared to the CG.

Student Engagement Levels: Survey data were analyzed using descriptive statistics and comparative analysis to explore whether the EG showed higher levels of engagement due to the teachers' enhanced use of gestures and posture.

Retention Analysis: The retention test scores were compared between the two groups to evaluate whether gestures and posture contributed to better long-term retention of the language material.

The results of this analysis would provide insights into the extent to which gesture and posture interventions enhance English language teaching effectiveness.

4. Results and analysis

The data from **Table 1** and **Figure 5** show a notable improvement in comprehension scores in both the EG and CG, with a more pronounced effect in the EG. The pre-intervention mean comprehension score for the EG was 61.48, which increased to 68.11 post-intervention, resulting in a mean improvement of 6.62 points. In contrast, the CG proved a modest improvement, with pre-intervention scores increasing from 60.12 to 63.08, reflecting a mean improvement of only 2.96 points. The statistical analysis using a t-test revealed that the improvement in the EG was highly significant, with a *T*-statistic of 3.27 and a *P*-value of 0.002. This suggests that using gestures and posture in the EG led to a meaningful and statistically significant enhancement in student comprehension. Though present, CG's improvement was less

substantial, emphasizing the practical impact of integrating non-verbal communication into the teaching process.

Table 1. Improvement in student comprehension scores.

Category	Experimental	Control
Pre-Intervention Mean	61.48	60.12
Post-Intervention Mean	68.11	63.08
Mean Improvement	6.62	2.96
T-Statistic	3.27	N/A
P-Value	0.002	N/A

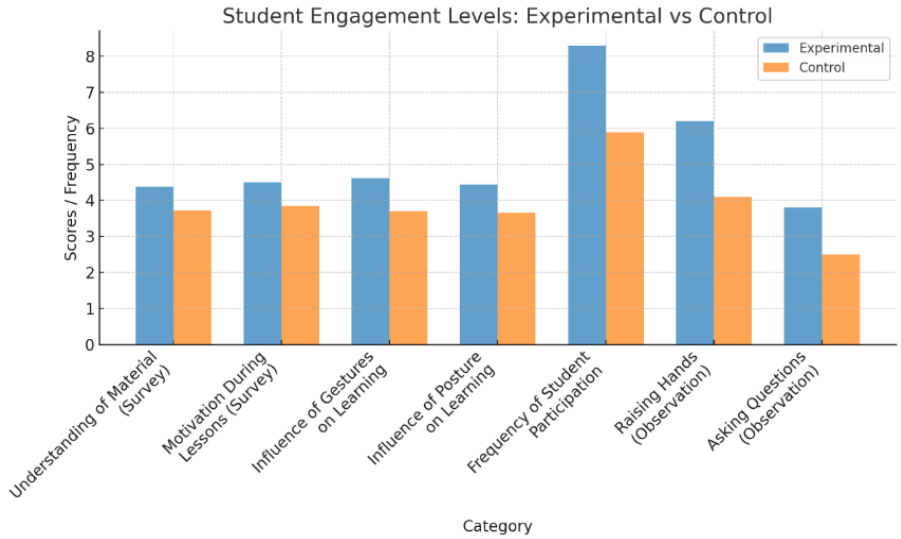

Figure 5. Student comprehension scores.

The findings in **Table 2** and **Figure 5** further highlight the positive influence of gesture and posture on student engagement. Students in the EG reported higher levels of understanding of the material, with a mean score of 4.38 compared to 3.72 in the CG. Similarly, motivation during lessons was notably higher in the EG (4.51) compared to the CG (3.85), suggesting that using gestures and open posture contributed to creating a more engaging and motivating classroom environment. The influence of gestures and posture on learning was particularly significant in the EG. Students rated the influence of gestures on learning as 4.62 compared to 3.70 in the CG and the influence of posture on learning as 4.44 compared to 3.66. These higher ratings indicate that students perceived non-verbal communication as essential for enhancing their understanding of English language concepts. In addition to survey responses, classroom observation data revealed increased participation in the EG. Students in the EG participated more frequently, raising their hands an average of 6.2 times per session, compared to 4.1 times in the CG. They also asked more questions during lessons, with an average of 3.8 questions per session, compared to 2.5 in the CG. This increase in interaction suggests that students in the EG were more actively engaged in the learning process, likely due to the teachers' purposeful use of gestures and movement in the classroom.

Table 2. Student engagement levels.

Category	EG	CG
Understanding of Material (Survey)	4.38	3.72
Motivation During Lessons (Survey)	4.51	3.85
Influence of Gestures on Learning	4.62	3.70
Influence of Posture on Learning	4.44	3.66
Frequency of Student Participation	8.3 Times/Session	5.9 Times/Session
Raising Hands (Observation)	6.2 Times/Session	4.1 Times/Session
Asking Questions (Observation)	3.8 Times/Session	2.5 Times/Session

The data in **Table 3** and **Figure 6** reveal substantial differences in the types and frequency of gestures used by teachers in the EG and CG. Teachers in the EG used an average of 34.7 gestures per session, nearly double the frequency used by teachers in the control group (18.9 gestures per session). This increased use of gestures likely contributed to the higher student engagement and comprehension levels observed in the EG. When analyzing specific types of gestures, the EG consistently used more gestures across all categories. Iconic gestures, which visually represent the content being taught, were used an average of 12.3 times per session in the EG, compared to 6.5 times in the control group. Deictic gestures, used for pointing or directing attention, were employed 9.8 times per session in the EG versus 4.9 times in the CG. Metaphoric gestures, which help convey abstract concepts, were used 7.5 times per session in the EG, compared to 4.2 times in the control group. Even beat gestures, which help emphasize speech rhythmically, were more frequent in the EG (5.1 gestures per session) compared to the control group (3.3 gestures per session). The higher frequency and varied use of gestures in the EG reflect the teachers' conscious effort to integrate non-verbal communication as a pedagogical tool. These gestures likely played a critical role in scaffolding students' understanding of complex language concepts, improving comprehension and engagement outcomes.

Table 3. Types and frequency of gestures used by teachers.

Category	EG	CG
Total Gesture Frequency (Per Session)	34.7 Gestures	18.9 Gestures
Iconic Gestures (Per Session)	12.3 Gestures	6.5 Gestures
Deictic Gestures (Per Session)	9.8 Gestures	4.9 Gestures
Metaphoric Gestures (Per Session)	7.5 Gestures	4.2 Gestures
Beat Gestures (Per Session)	5.1 Gestures	3.3 Gestures

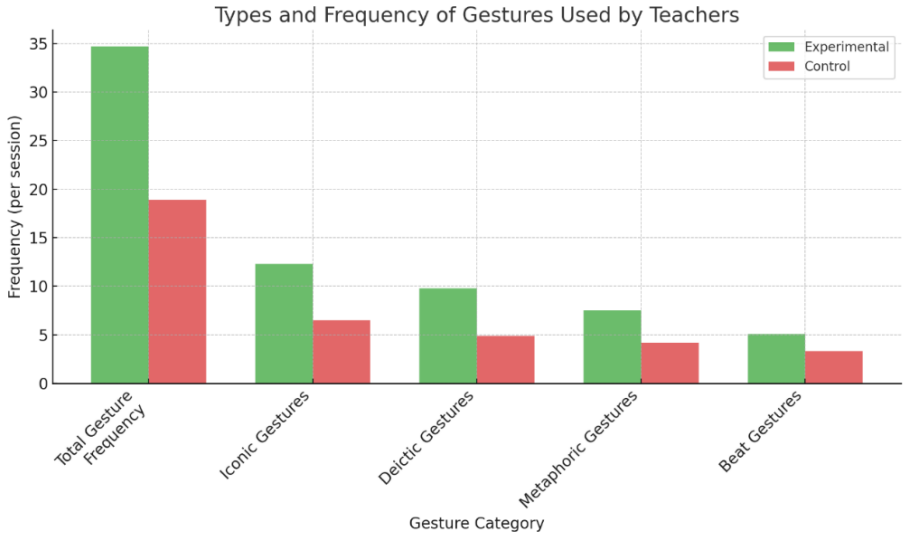

Figure 6. Gestures used by teachers.

The data in **Table 4** highlight the significant role of different types of gestures in improving student comprehension. In the EG, students rated the effectiveness of iconic gestures (visually representing content) at 4.58, compared to 3.66 in the CG. This considerable difference indicates that iconic gestures helped students better grasp and retain language concepts through visual representation. Deictic gestures, used for pointing or directing attention, were rated even higher in the EG (4.72) than the CG (3.83). Deictic gestures likely played a pivotal role in guiding students' focus to key aspects of language instruction, such as words or grammar structures, thereby improving their comprehension.

Table 4. Impact on student comprehension (Survey).

Gesture Type	EG	CG
Iconic Gestures	4.58	3.66
Deictic Gestures	4.72	3.83
Metaphoric Gestures	4.43	3.61
Beat Gestures	4.10	3.45

Metaphoric gestures, which help convey abstract ideas, were also more favorably rated in the EG (4.43) than in CG (3.61). These gestures have helped students better understand abstract or complex language concepts that might be difficult to explain using only verbal language. Finally, beat gestures, used to emphasize speech rhythm, were rated at 4.10 in the EG and 3.45 in the control group. Although beat gestures were not as highly rated as the other gesture types, they still contributed to student comprehension by providing rhythmic emphasis to key points in the lesson, making the information more accessible to follow and remember.

The findings from **Table 5** and **Figure 7** emphasize the importance of posture and movement in teaching. The average posture stability score for teachers in EG was 4.65, compared to 3.78 in CG. This suggests that teachers in the EG maintained more open, stable postures, which likely contributed to their classroom presence and student engagement. The experimental group also exhibited a higher frequency of open

postures (14.2 times per session) than the CG (8.5 times). Open postures project confidence and approachability, helping to create a more engaging learning environment. In contrast, the control group demonstrated a higher frequency of closed postures (9.1 times per session vs. 4.8 in EG), which may have negatively impacted student engagement.

Table 5. Posture stability and movement patterns.

Category	EG	CG
Average Posture Stability Score	4.65	3.78
Frequency of Open Postures (Per Session)	14.2 Times	8.5 Times
Closed Postures (Per Session)	4.8 Times	9.1 Times
Total Distance Traveled (Per Session)	12.6 M	6.9 M
Time Spent in Front of Classroom (%)	52%	73%
Time Spent Moving Through Classroom (%)	48%	27%
Average Time Spent in Interaction Zones (Minutes)	16.5 Min	8.4 Min

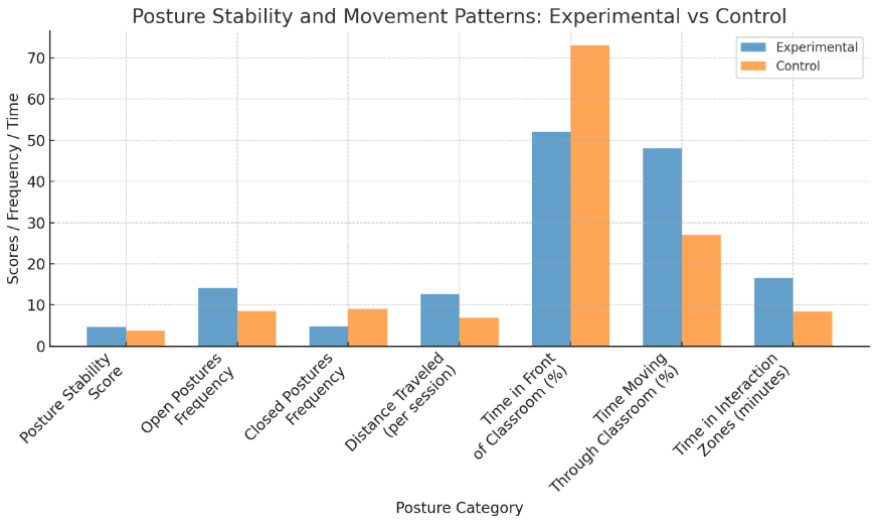

Figure 7. Posture stability and movement patterns.

Regarding movement patterns, teachers in the EG traveled a greater total distance (12.6 m per session) than the CG (6.9 m per session). This suggests that purposeful movement around the classroom, rather than remaining static, may have contributed to higher levels of student engagement. The time spent in front of the classroom was lower in the EG (52%) compared to the CG (73%), while the EG spent more time moving through the classroom (48% vs. 27%). Teachers in the EG also spent more time in interaction zones (16.5 min per session) than the CG (8.4 min), indicating more direct engagement with students. These movement patterns likely contributed to improved classroom dynamics and student participation.

The retention data from **Table 6** show that students in the EG outperformed those in the CG on retention tests conducted two weeks after the intervention. The overall retention test score for the EG was 75.3%, compared to 66.8% in CG. This difference suggests that using gestures and posture enhanced immediate comprehension and contributed to better long-term retention of language concepts. When looking at

specific areas, the EG achieved higher vocabulary retention (78.9%) than the CG (68.5%). Similarly, retention of grammar rules was better in the EG (72.6%) than in the CG (64.2%). Finally, the retention of comprehension strategies was also higher in the EG (74.1%) than in CG (67.3%). The statistical analysis of these results revealed a *P*-value of 0.003, indicating that the differences in retention between the EG and CG are statistically significant. This suggests that using gestures and posture helps students understand and engage with the material during lessons and plays a critical role in reinforcing the long-term retention of language concepts.

Table 6. Retention of language concepts.

Category	EG	CG
Retention Test Score (Overall)	75.3%	66.8%
Vocabulary Retention (%)	78.9%	68.5%
Grammar Rules Retention (%)	72.6%	64.2%
Comprehension Strategies Retention (%)	74.1%	67.3%
Statistical Significance (*P*-Value)	0.003	N/A

According to **Table 7**, most teachers in the EG perceived significant improvements in student engagement and comprehension. 92% of teachers in the EG reported improvements in student engagement, compared to only 65% in the CG. Similarly, 89% of teachers in the EG observed improvements in comprehension compared to 62% in the CG. These reflections suggest that teachers were more aware of and confident in the effectiveness of gestures and posture in enhancing the learning environment. Teachers in the EG also demonstrated a higher awareness of gesture use, with a survey score of 4.75 compared to 3.84 in the CG. Awareness of posture use was similarly higher in the EG, with a score of 4.63 compared to 3.71 in CG. This reflects the impact of the intervention in helping teachers recognize and consciously use non-verbal communication techniques. Additionally, teachers rated the perceived effectiveness of gestures at 4.85 in the EG, compared to 3.88 in the control group, indicating that teachers found gestures to be a powerful tool for enhancing comprehension and engagement. The perceived effectiveness of posture was also higher in the EG, at 4.58, compared to 3.66 in the CG, further reinforcing the importance of non-verbal communication in the classroom.

Table 7. Teacher reflections and perceptions.

Category	EG	CG
Perceived Improvement in Engagement	92% of Teachers	65% of Teachers
Perceived Improvement in Comprehension	89% of Teachers	62% of Teachers
Awareness of Gesture Use (Survey Score)	4.75	3.84
Awareness of Posture Use (Survey Score)	4.63	3.71
Perceived Effectiveness of Gestures	4.85	3.88
Perceived Effectiveness of Posture	4.58	3.66

The results from the Repeated Measures ANOVA in **Table 8** and **Figure 8** show significant improvements in comprehension, engagement, and retention scores over

time, particularly in the EG. For comprehension scores, the experimental group improved from a pre-intervention mean of 61.48 to a post-intervention mean of 68.11, with a highly significant *F*-statistic of 24.36 and a *P*-value of 0.001. This indicates that the intervention had a meaningful and statistically significant impact on comprehension. The CG also showed some improvement, with scores rising from 60.12 to 63.08, but the effect was less pronounced (*F*-statistic of 8.92, *P*-value of 0.012). The results for engagement scores similarly showed a significant improvement in the EG, with scores increasing from 3.92 to 4.51 (*F*-statistic of 18.27, *P*-value of 0.002).

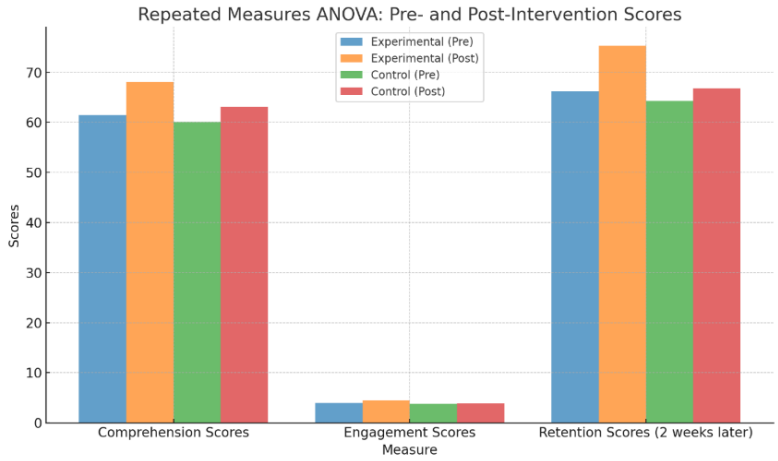

Figure 8. ANOVA Results.

Table 8. Repeated measures ANOVA.

Measure	Group	Pre-Intervention Mean	Post-Intervention Mean	*F*-Statistic	*P*-Value
Comprehension Scores	EG	61.48	68.11	24.36	0.001
	CG	60.12	63.08	8.92	0.012
Engagement Scores	EG	3.92	4.51	18.27	0.002
	CG	3.78	3.85	5.31	0.035
Retention Scores (2 weeks later)	EG	66.15	75.30	22.15	0.001
	CG	64.30	66.80	6.88	0.021

In contrast, the CG showed a marginal increase, from 3.78 to 3.85 (*F*-statistic of 5.31, *P*-value of 0.035). For retention scores measured two weeks later, the EG improved from 66.15 to 75.30 (*F*-statistic of 22.15, *P*-value of 0.001), while the CG showed a minor increase, from 64.30 to 66.80 (*F*-statistic of 6.88, *P*-value of 0.021). These results indicate that using gestures and posture enhances immediate comprehension and engagement and positively affects long-term retention of language concepts.

The T-test results in **Table 9** and **Figure 9** further confirm the significant impact of the intervention. The paired *T*-test for comprehension scores in the EG showed a mean difference of 6.63 with a *T*-statistic of 5.28 and a *P*-value of 0.001, indicating a significant improvement within the group. The CG also showed some improvement, with a mean difference of 2.96 (*T*-statistic of 3.11, *P*-value of 0.015), but the improvement was less substantial.

Table 9. T-test (paired and independent).

Measure	Test Type	Group	Mean Difference	*T*-Statistic	*P*-Value
Comprehension Scores	Paired T-Test	EG	6.63	5.28	0.001
		CG	2.96	3.11	0.015
	Independent T-Test	EG vs. CG	N/A	3.27	0.002
Engagement Scores	Paired T-Test	EG	0.59	4.82	0.002
		CG	0.07	1.92	0.065
	Independent T-Test	Exp vs. Control	N/A	2.85	0.006
Retention Scores (2 Weeks Later)	Paired T-Test	EG	9.15	5.09	0.001
		CG	2.50	2.22	0.039
	Independent T-Test	EG vs. CG	N/A	3.75	0.001

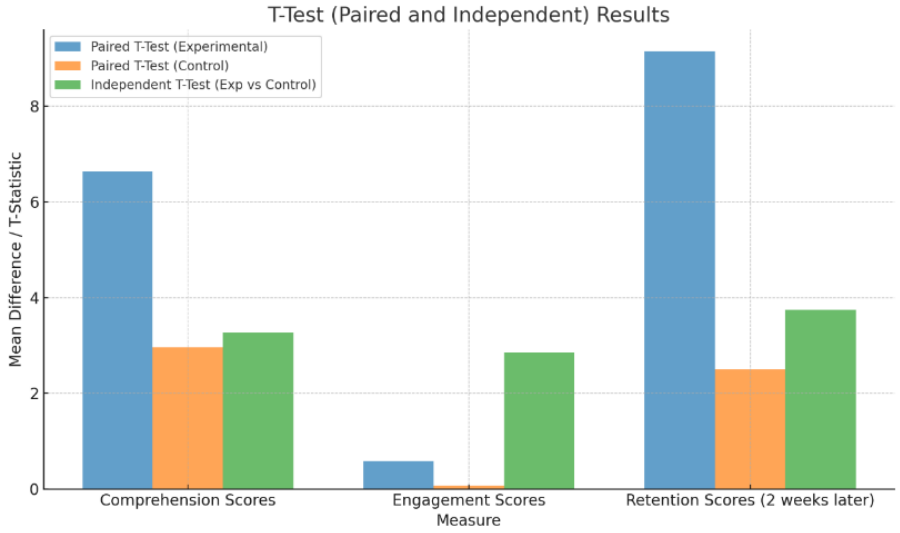

Figure 9. T-test results.

For engagement scores, the EG proved a mean improvement of 0.59 with a *T*-statistic of 4.82 and a *P*-value of 0.002, while the CG showed a minor improvement (mean difference of 0.07, *T*-statistic of 1.92, *P*-value of 0.065). The independent T-test comparing post-intervention scores between the EG and CG showed a significant difference (*T*-statistic of 2.85, *P*-value of 0.006).

For retention scores, the EG saw a substantial improvement with a mean difference of 9.15 (*T*-statistic of 5.09, *P*-value of 0.001), while the CG showed a minor improvement (mean difference of 2.50, *T*-statistic of 2.22, *P*-value of 0.039). The independent T-test comparing retention scores between the two groups confirmed a significant difference (*T*-statistic of 3.75, *P*-value of 0.001), demonstrating that the EG retained language concepts better than the CG over the long term.

The results from **Table 10** and **Figure 10** demonstrate significant relationships between the frequency and types of teacher gestures and various student outcomes, including comprehension, engagement, and retention. The analysis reveals a strong positive correlation between the frequency of gestures and comprehension scores, with a coefficient (β) of 0.72. This indicates that as teachers increased the frequency of gestures, student comprehension improved significantly. The *T*-statistic of 5.54 and a

P-value of 0.001 confirm the statistical significance of this relationship, with an R^2 value of 0.48, indicating that the frequency of gestures can explain 48% of the variation in comprehension scores.

Table 10. Regression analysis.

Predictor Variable	Outcome Variable	Coefficient (β)	Standard Error	*T*-Statistic	*P*-Value	R^2
Frequency of Gestures	Comprehension Scores	0.72	0.13	5.54	0.001	0.48
Iconic Gestures	Engagement Scores	0.65	0.11	5.91	0.001	0.53
Deictic Gestures	Comprehension Scores	0.79	0.10	7.90	0.001	0.61
Metaphoric Gestures	Engagement Scores	0.58	0.12	4.83	0.002	0.41
Total Gesture Frequency	Retention Scores	0.68	0.09	7.56	0.001	0.56

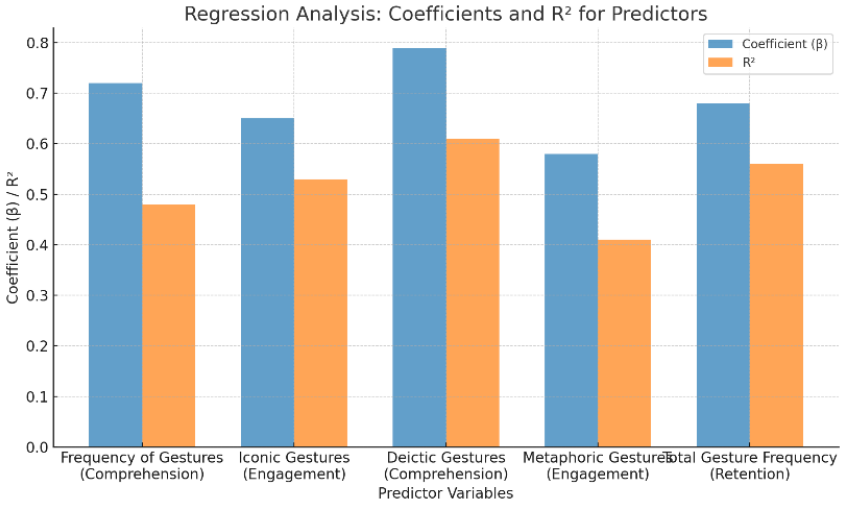

Figure 10. Regression analysis.

Regarding iconic gestures, which visually represent content, the data show a strong positive impact on engagement scores (β = 0.65, *T*-statistic = 5.91, *P*-value = 0.001, R^2 = 0.53). This suggests that using iconic gestures significantly increases student engagement, as more than half of the variation in engagement scores can be attributed to using these gestures. Deictic gestures, which direct attention to specific elements, had the highest impact on comprehension scores, with a β value of 0.79, a *T*-statistic of 7.90, and an R^2 value of 0.61, indicating that the use of deictic gestures explained 61% of the variance in comprehension scores.

Similarly, metaphoric gestures—used to explain abstract concepts—were also significantly associated with engagement scores, with a β value of 0.58, a *T*-statistic of 4.83, and an R^2 of 0.41. This means that using metaphoric gestures could explain 41% of the variation in engagement scores. Lastly, the total frequency of gestures had a strong positive correlation with retention scores, with a β value of 0.68, a *T*-statistic of 7.56, and an R^2 of 0.56. This suggests that the more gestures teachers use, the better students can retain the material over time.

The Cohen's d effect size calculations in **Table 11** further reinforce the substantial impact of the intervention on student outcomes. The effect size for comprehension scores between the EG and CG was 1.83, considered large. This

indicates a significant practical difference in comprehension performance between students who experienced enhanced gesture use and those who did not.

Table 11. Effect size calculation (Cohen's *d*).

Measured Scores	Group	Mean Difference	Standard Deviation (Pooled)	Cohen's *d*	Effect Size Interpretation
Comprehension	EG vs. CG	5.03	2.75	1.83	Large
Engagement	EG vs. CG	0.66	0.37	1.78	Large
Retention (2 Weeks Later)	EG vs. CG	8.50	4.22	2.01	Large

The effect size for engagement scores was similarly large ($d = 1.78$), suggesting that the use of gestures and posture substantially impacted student participation and motivation during lessons. This significant effect size demonstrates that the intervention had statistical significance and a meaningful, real-world impact on how engaged students were in the classroom.

Finally, the effect size for retention scores, measured 2 weeks after the intervention, was 2.01, the largest of the three measures. This enormous effect size underscores the effectiveness of gestures and posture in reinforcing the long-term retention of language concepts. The substantial difference between the EG and CG in retention suggests that students in the EG were far better able to recall material after the intervention, further emphasizing the practical value of integrating non-verbal communication techniques into teaching.

5. Conclusion and future work

The findings of this study provide clear evidence that the deliberate use of gestures and posture significantly enhances the effectiveness of English language teaching. Teachers in the EG, who received training in integrating non-verbal communication, demonstrated substantial improvements in student comprehension, engagement, and retention compared to the CG. Specifically, using iconic, deictic, and metaphoric gestures alongside open and dynamic posture contributed to greater student participation, more focused attention, and improved long-term retention of language concepts. The results indicate that non-verbal communication, particularly gestures, is a controlling pedagogical tool that visually reinforces language content, making it more accessible and understandable for students. Additionally, teachers' posture and movement within the classroom positively influenced student perceptions of engagement and approachability, creating a more interactive and inclusive learning environment. This study highlights the practical applications of integrating non-verbal communication strategies into language teaching and underscores their potential to improve immediate comprehension and long-term retention. Educators should consider incorporating a structured approach to gestures and posture in their teaching practices, particularly in language learning contexts, to optimize student outcomes. Future research could expand on these findings by exploring the impact of specific gesture types on different age groups or language proficiency levels. Additionally, studies that examine the long-term effects of sustained non-verbal communication interventions would provide further insights into how these approaches can support ongoing language development. Overall, the integration of gestures and posture

presents a promising avenue for enhancing language education and the development of more engaging, practical classroom experiences.

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