# Motor activity and foreign language learning in preschool: A review of movement-based and total physical response interventions

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**Received:** 2026-01-27
**Accepted:** 2026-03-31
**Published:** 2025-04-04

A – Research concept and design
B – Collection and/or assembly of data
C – Data analysis and interpretation
D – Writing the article
E – Critical revision of the article
F – Final approval of article



## ABSTRACT

**Background:** Movement may support early foreign-language learning through embodied learning, but the preschool evidence base is fragmented.
**Objective:** To review empirical studies on movement-based and Total Physical Response (TPR) interventions for foreign-language learning in preschool children.
**Method:** This study employed a systematic review design based on PRISMA 2020 guidelines, involving database searches and citation tracking to identify empirical studies on movement-based and Total Physical Response (TPR) interventions in preschool foreign-language learning. Studies were screened using predefined eligibility criteria and appraised using the Mixed Methods Appraisal Tool (MMAT). Data from eligible studies were extracted and synthesized narratively due to methodological heterogeneity.
**Results:** Eight studies met the inclusion criteria. Across stronger controlled studies, semantically integrated movement generally produced more favorable vocabulary and verbal memory outcomes than sedentary teaching or less integrated movement. Evidence focused specifically on TPR was positive in terms of engagement and short-term learning, but methodologically heterogeneous and less robust.
**Conclusion:** Current preschool evidence supports the promise of integrated movement-based language teaching, particularly when movement is tightly aligned with instructional content. However, the evidence base remains small, largely limited to vocabulary-related outcomes, and further rigorous preschool trials are needed to clarify optimal implementation and the distinct contribution of TPR.

**Keywords:** early childhood education, embodied learning, foreign language, physical activity, total physical response, vocabulary learning.

**How to cite this article:** Valentini, M., Simone, N., & Beretta, A. (2025). Motor activity and foreign language learning in preschool: A review of movement-based and total physical response interventions. *Physical Education and Sports: Studies and Research*, *5*(1), 93-105. https://doi.org/10.56003/pessr.v4i1.694

## INTRODUCTION

Early foreign-language exposure in preschool is usually justified by developmental plasticity, rich sensorimotor learning, and the motivational value of playful classroom routines. At the same time, young children do not learn effectively through decontextualized verbal explanation alone. They benefit from concrete, meaningful, and socially mediated experiences in which words are linked to actions, objects, and events. This makes movement-based language teaching particularly relevant in early childhood education.

The theoretical background for this line of work is commonly discussed under the rubric of embodied cognition or embodied learning. In this perspective, language learning is not treated as a purely abstract symbolic process; sensorimotor activity can contribute to the encoding, retrieval, and stabilization of verbal memory traces. Recent syntheses in language education and embodied learning have reinforced this point, while also showing that the effects of movement are not uniform. Interventions tend to work better when the movement is highly relevant to the academic content and tightly integrated with the learning task rather than merely added as a break or motivational device (Jusslin et al., 2022; Mavilidi et al., 2022; Macedonia, 2025; Liu et al., 2025).

Within foreign-language pedagogy, Total Physical Response (TPR) remains the most recognizable movement-based approach. Originally proposed by Asher (1969), TPR uses teacher commands and physical responses to connect comprehension, action, and meaning. In practice, however, preschool movement-based language teaching is broader than classical TPR. The literature includes gesture-enriched vocabulary instruction, whole-body enactment of word meaning, active-learning lessons in which physical activity is embedded into language content, and descriptive classroom studies explicitly framed as TPR. Treating all of these approaches as equivalent risks obscures important methodological and conceptual differences.

From a developmental perspective, this framework is particularly pertinent to preschool education. Young children typically learn through action, imitation, repetition, and socially shared routines; they rarely encounter new language as an isolated verbal code. When words are paired with gestures, actions, spatial movement, objects, and playful interaction, children receive multiple cues that can support attention and meaning-making simultaneously. A recent mixed-methods review of embodied language learning argued that bodily involvement may facilitate learning by linking meaning, action, emotion, and attention within a single instructional episode (Jusslin et al., 2022). Macedonia (2025) similarly emphasizes that sensorimotor participation can create richer multimodal memory traces that strengthen later recall. Seen in this light, movement-based language teaching is not simply a motivational embellishment; it may change how linguistic information is encoded in memory.

Embodied approaches can also be interpreted through cognitive load theory. From this perspective, movement may support learning when it simplifies the mapping between a new word and its referent, guides attention toward task-relevant information, and increases germane processing without imposing unnecessary extraneous load (Sweller et al., 2019). This distinction is especially important in preschool settings, where attentional and working-memory resources are limited and where overly complex activities may become distracting rather than helpful. Consistent with this reasoning, Mavilidi et al. (2022) proposed a taxonomy based on

the relevance of the movement to the learning content and the degree to which the movement is integrated into the academic task. This framework helps explain why preschool studies may produce mixed results when they group very different interventions under broad labels such as movement-based learning or TPR. Gesture-rich vocabulary enactment, content-relevant whole-body activity, and generic movement breaks are not theoretically equivalent, even if all involve children moving.

In revising the paper, we therefore narrowed the evidence base to studies that directly addressed preschool movement-based foreign-language learning or closely related novel-language tasks, and we used broader embodied-learning literature only to interpret the findings rather than to inflate the primary evidence base.

This review aims to evaluate empirical evidence on the role of motor activity in preschool foreign-language learning, with particular attention to movement-based vocabulary instruction and TPR-related interventions. Two questions guided the review:

1. What evidence is available that movement-based interventions improve preschool children's foreign-language vocabulary learning or related verbal-memory outcomes?
2. What can be concluded specifically about preschool TPR studies once study design and methodological quality are taken into account?

# METHODS

## Study Design

This study employed a systematic review design based on PRISMA 2020 guidelines, involving database searches and citation tracking to identify empirical studies on movement-based and Total Physical Response (TPR) interventions in preschool foreign-language learning. Studies were screened using predefined eligibility criteria and appraised using the Mixed Methods Appraisal Tool (MMAT). Data from eligible studies were extracted and synthesized narratively due to methodological heterogeneity.

## Eligibility Criteria

Studies were eligible when they met all of the following criteria: (a) participants were preschool children, kindergarten children, or pre-primary children (approximately 3–6 years old); (b) the intervention involved physical activity, semantically meaningful body movement, gestures, enactment, or a TPR-related approach during foreign-language, second-language, or novel-language learning; (c) the report included at least one language-related outcome, such as vocabulary learning, recall, retention, comprehension, or verbal memory linked to the language task; and (d) the report was an empirical peer-reviewed journal article or peer-reviewed conference paper. Studies were excluded if they focused solely on first-language development, involved school-aged or mixed-age samples without extractable preschool results, used physical activity without a language outcome, or were reviews, meta-analyses, editorials, or purely theoretical papers.

## Search Strategy and Selection Process

The search was updated in PubMed and Google Scholar. Because preschool foreign-language movement research is scattered across education, psychology, and

language-teaching outlets, database searches were supplemented by backward and forward citation tracking of core preschool studies and recent syntheses. The following search strings were used and adapted to database syntax:

1. ("preschool" OR "kindergarten" OR "pre-primary" OR "early childhood") AND ("foreign language" OR "second language" OR "English" OR "novel language") AND ("physical activity" OR movement OR gesture* OR enact* OR embodied OR "total physical response" OR TPR)
2. ("preschool" OR "kindergarten" OR "early childhood") AND ("foreign language" OR "novel language" OR vocabulary) AND (gesture* OR enact* OR "total physical response" OR TPR)

Reference lists and citation links were then checked for additional records from the same research line, including the preschool studies by Tellier, Rowe and colleagues, Mavilidi and colleagues, Toumpaniari and colleagues, and the recent syntheses by Jusslin et al. (2022), Mavilidi et al. (2022), Macedonia (2025), and Liu et al. (2025). Search terms were formulated in English to maximize retrieval in international databases.

## Study Selection Including PRISMA 2020 Flow Diagram

Study selection followed PRISMA 2020 as a reporting and decision framework (Page et al., 2021). Given the instability of raw Google Scholar hit counts across searches, the flow diagram (Figure 1) reports the number of unique reports evaluated immediately after manual deduplication, rather than the total number of search-engine results. Twenty unique reports were screened in full-text form. Twelve were excluded after eligibility assessment: five because the sample was not preschool-specific or did not permit extraction of preschool results, four because the study did not report a direct movement-based foreign-language outcome, and three because the paper was a review or meta-analysis rather than a primary empirical study. Eight studies were retained for qualitative synthesis.

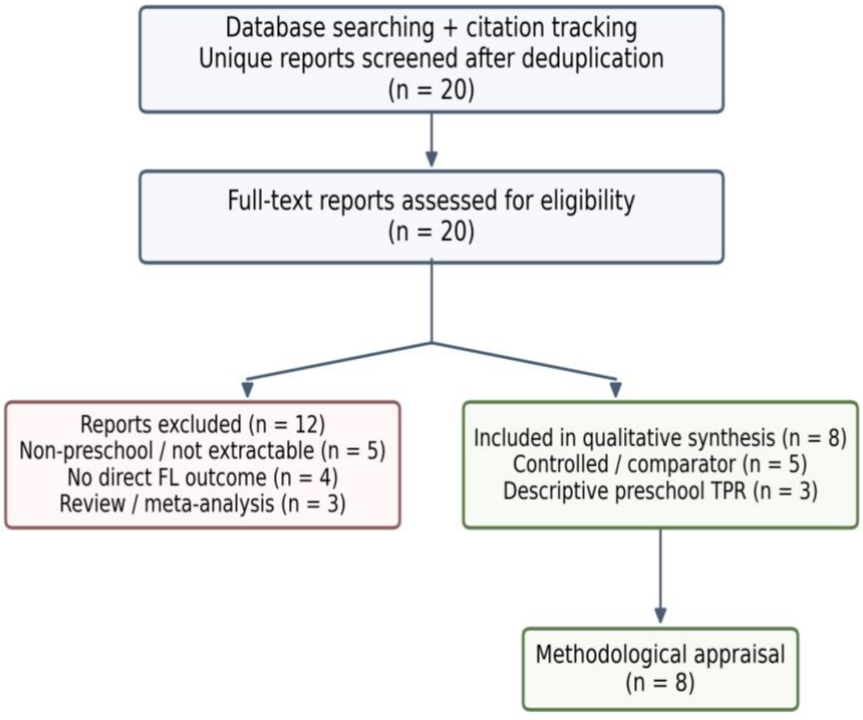


**Figure 1.** PRISMA 2020 flow diagram for the study-selection process

### Evaluation of Article Quality

Because the included evidence comprised randomized, quasi-experimental, within-subject, and descriptive qualitative designs, methodological quality was appraised with the Mixed Methods Appraisal Tool (MMAT, version 2018) (Hong et al., 2018). The MMAT was chosen because it enables design-appropriate appraisal within a mixed-evidence base. For each study, attention was paid to the clarity of the sampling strategy, the adequacy of the comparator or control condition when relevant, the suitability of the outcome measures, the risk of confounding, the completeness of the reported data, and the coherence between the research question, methods, and conclusions. In line with MMAT guidance, no overall numerical score was calculated; instead, studies were discussed narratively and assigned an overall confidence judgment (higher, moderate, or lower) to support interpretation (Table 1).

### Data Extraction

A structured extraction matrix was used to record authors, year, country, sample characteristics, type of movement-based intervention, comparator condition, study duration, language-related outcomes, and principal findings. Because the studies were heterogeneous in design, outcome metrics, and intervention format, a quantitative meta-analysis was not attempted. The synthesis was therefore narrative and organized around study design and outcome pattern.

## RESULTS

### Study Selection

Eight empirical studies published between 2008 and 2025 met the eligibility criteria (Table 2). The studies were conducted in France, the United States, Australia, Greece, Indonesia, China, and Spain. Five studies used a controlled or comparator design (Tellier, 2008; Rowe et al., 2013; Mavilidi et al., 2015; Toumpaniari et al., 2015; Martin Martinez et al., 2025), whereas three were descriptive or qualitative preschool TPR reports (Ummah, 2017; Mariyam & Musfiroh, 2019; Duan, 2021).

**Table 1.** Narrative MMAT-based Appraisal of the Included Studies

| Study | Design | Main methodological concerns | Overall confidence |
|---|---|---|---|
| Tellier (2008) | Controlled experiment | Small sample and narrow outcome scope, but direct alignment between intervention and vocabulary outcome. | Moderate |
| Rowe et al. (2013) | Within-subject comparator design | Methodologically informative, though findings depend on task format and child characteristics; not a large trial. | Moderate |
| Mavilidi et al. (2015) | Experimental multi-condition study | Good comparator structure and repeated testing; strongest direct preschool evidence despite typical classroom-study constraints. | Higher |
| Toumpaniari et al. (2015) | Quasi-experimental comparator study | Clear comparison conditions and relevant outcomes, but non-randomized features leave some room for confounding. | Moderate to higher |
| Ummah (2017) | Descriptive qualitative | No robust comparator, descriptive analysis, and limited causal inference. | Lower |

| Study | Design | Main methodological concerns | Overall confidence |
|---|---|---|---|
| Mariyam & Musfiroh (2019) | Descriptive qualitative | Small sample, no control group, and short-term outcome emphasis. | Lower |
| Duan (2021) | Descriptive pre/post study | Very small sample and no control condition, though pedagogically informative. | Lower |
| Martin Martinez et al. (2025) | Cluster randomized controlled trial | Strongest recent design with explicit comparator groups and structured measurement; classroom clustering still limits precision. | Higher |

*Note. MMAT = Mixed Methods Appraisal Tool. In line with MMAT guidance, studies were discussed narratively and not reduced to a single numerical score.*

**Table 2.** Characteristics of the Studies Included in the Review

| Study | Country | Sample | Intervention / comparator | Design, duration, and main findings |
|---|---|---|---|---|
| Tellier (2008) | France | 20 children; mean age 5 years 5 months | Learning 8 English words with iconic gestures versus pictures | Controlled classroom experiment; short instructional sequence. Gesture-supported teaching produced better memorisation than picture-supported teaching. |
| Rowe et al. (2013) | United States | 62 preschool children | Novel-language word learning with words only, words+gestures, or words+pictures | Within-subject comparator design. Nonverbal aids were useful, but effects varied by task and child characteristics rather than showing a uniform main effect. |
| Mavilidi et al. (2015) | Australia | 111 preschool children | Italian vocabulary taught through integrated physical exercise, non-integrated exercise, gestures, or conventional verbal teaching | Multi-condition experimental study; 4 weeks. Integrated whole-body movement led to the best vocabulary learning and retention. |
| Toumpaniari et al. (2015) | Greece | 67 children; mean age 4 years | English animal names taught through physical activity+gestures, gestures only, or a conventional condition | Quasi-experimental comparator study; 4 weeks. The combined physical-activity-and-gesture condition produced the best learning and was preferred by children. |

| Study | Country | Sample | Intervention / comparator | Design, duration, and main findings |
|---|---|---|---|---|
| Ummah (2017) | Indonesia | 30 kindergarten students (approximately 6 to <7 years) | TPR-based English lessons using commands, demonstrations, and songs | Descriptive qualitative conference paper. Reported improved participation, interest, and classroom engagement during English lessons. |
| Mariyam & Musfiroh (2019) | Indonesia | 15 children aged 5–6 years | TPR-based English vocabulary instruction with physical responses and games | Descriptive qualitative study. Short-term vocabulary acquisition was reported, with better performance for nouns and verbs than for adjectives. |
| Duan (2021) | China | 6 preschool children | Four-month TPR-based preschool English program | Descriptive pre/post classroom study. Reported better comprehension and vocabulary recall, alongside implementation difficulties for abstract concepts. |
| Martin Martinez et al. (2025) | Spain | 99 children aged 3–6 years | English lessons delivered with light PA, moderate-to-vigorous PA, or sedentary teaching | Cluster randomized controlled trial; 10 weeks. Both active-learning groups improved free recall and verbal memory versus control; the higher-intensity group showed the largest gains. |

**Characteristics of Included Studies**

Sample sizes ranged from 6 to 111 children. The controlled studies mostly examined vocabulary learning under short interventions lasting from single instructional sessions to 10-week programs. The descriptive TPR studies typically focused on classroom feasibility, learner participation, and short-term vocabulary growth. Most interventions dealt with concrete vocabulary, body-part commands, animal names, or imageable lexical items. This is important because the available preschool evidence is much stronger for concrete vocabulary than for abstract language learning.

**Methodological Quality**

Methodological quality varied markedly. The strongest evidence came from Mavilidi et al. (2015) and Martin Martinez et al. (2025), who used multi-condition or cluster-randomized designs, explicit comparison groups, and structured outcome assessment. Toumpaniari et al. (2015) also provided comparatively strong evidence, although the quasi-experimental structure leaves more room for residual confounding than a fully randomized design. Tellier (2008) and Rowe et al. (2013) were methodologically informative but more limited in scale and design complexity. The three preschool TPR studies by Ummah (2017), Mariyam & Musfiroh (2019),

and Duan (2021) were valuable for pedagogical description. However, each had important limitations related to sample size, confounding control, or descriptive analysis. Their conclusions should therefore be interpreted as feasibility-oriented rather than strongly causal.

### Narrative Synthesis of Findings

The controlled evidence points in a broadly consistent direction: movement is most useful when it is meaningfully connected to the lexical content being taught. Tellier (2008) compared gesture-based teaching with picture-based teaching in very young learners and found better memorization for the gesture condition. This early study is important because it links preschool foreign-language recall to meaningful body enactment rather than to movement in general.

Rowe et al. (2013) provided a more differentiated result. In their novel-language study with preschoolers, pictures and gestures were not universally superior for all children or all tasks. Instead, the usefulness of nonverbal aids depended on learner characteristics and assessment format. This finding cautions against simplistic claims and suggests that movement-based support should be treated as an instructional tool whose value may vary according to the child and the task.

Mavilidi et al. (2015) examined four conditions for learning Italian vocabulary: integrated physical exercise, non-integrated physical activity, gestures, and a conventional verbal condition. The integrated whole-body condition produced the best performance during the intervention and at later tests, indicating that the relevance between the movement and the target word matters.

Toumpaniari et al. (2015) similarly found that the combined physical-activity-and-gesture condition outperformed both the gesture-only condition and the conventional comparison condition in learning English animal names. Children also preferred the more active condition, which is pedagogically meaningful in preschool settings where enjoyment and attention are tightly linked.

The most recent direct evidence comes from Martin Martinez et al. (2025), a cluster-randomized trial in which preschool English lessons were delivered with either light physical activity, moderate-to-vigorous physical activity, or sedentary instruction. Both active-learning groups improved free recall and verbal-memory outcomes relative to the control condition, and the higher-intensity group generally showed the largest benefits. This study extends the earlier vocabulary-learning literature by showing that movement intensity may matter when active learning is embedded into preschool foreign-language lessons.

The three descriptive TPR studies all reported positive classroom experiences. Ummah (2017) described improved participation and interest during English lessons organized around commands, songs, and physical response. Mariyam & Musfiroh (2019) reported clear short-term vocabulary acquisition in 5–6-year-old children, with better performance for nouns and verbs than for adjectives. Duan (2021) reported gains in comprehension and vocabulary recall during a 4-month preschool English intervention, while also noting practical difficulties, particularly with abstract concepts and classroom management. Taken together, these studies support TPR as feasible and motivating, but, on their own, they do not establish strong causal effects.

## DISCUSSION

It is not movement per se that helps preschool foreign-language learning, but semantically relevant movement tightly integrated with the target content, delivered

in an age-appropriate, playful format. This interpretation aligns with broader embodied-learning syntheses, which show that relevance and integration are central moderators of effect (Jusslin et al., 2022; Mavilidi et al., 2022). It is also compatible with the recent review by Macedonia (2025), which emphasizes sensorimotor engagement as a mechanism for strengthening long-term second-language vocabulary learning, and with the 2025 meta-analysis by Liu et al. (2025), which found that more active and more strongly embodied approaches tend to produce larger learning benefits.

The most convincing studies are those by Tellier (2008), Mavilidi et al. (2015), Toumpaniari et al. (2015), and Martin Martinez et al. (2025), all of which directly connect movement to language-learning performance in preschool samples. Although the present review was intentionally restricted to preschool studies that directly assessed foreign-language or novel-language learning, the findings are more interpretable when placed alongside the broader Mavilidi program on integrated movement and learning. In non-language domains, follow-up preschool studies reported positive effects when movement was embedded directly into the academic content: integrated physical activities supported geography learning (Mavilidi et al., 2016), similar gains in learning and enjoyment were reported in a science lesson (Mavilidi et al., 2017), and numeracy research showed both immediate and delayed benefits when physical activity was tightly linked to the target task (Mavilidi et al., 2018). These studies were not included in the present synthesis because they do not directly address foreign-language outcomes. Nevertheless, they are theoretically informative because they point in the same direction as the language studies reviewed here: movement seems most educationally valuable when it carries representational meaning and forms part of the learning episode rather than being appended to it. The broader preschool literature therefore reinforces a cautious but coherent interpretation of the current evidence base.

The role of TPR should also be more carefully framed. TPR is pedagogically attractive in preschool because it reduces linguistic anxiety, supports participation, and turns comprehension into observable action. Therefore, the present review supports TPR primarily as a promising teaching approach rather than as a conclusively established evidence-based method based on preschool trials alone.

For practitioners, the present findings suggest that movement should not be treated as a generic classroom energizer detached from linguistic goals. More promising designs are those in which actions visibly represent the meaning of target words or support the retrieval of previously taught vocabulary. In preschool settings, this may involve acting out animals, classroom routines, spatial concepts, body-part commands, or everyday verbs. At the same time, the teacher introduces, repeats, and revisits the relevant language across sessions. Such practices are compatible with play-based pedagogy and may be particularly useful for children who benefit from active participation, reduced speaking pressure, and multimodal cues. At the same time, teachers should be cautious about excessive motor complexity, rapid pacing, or games whose connection to the lexical objective is weak, as these may dilute rather than strengthen the language-learning task. This also suggests a constructive role for collaboration between early childhood educators and physical education specialists, especially when active routines must fit real classroom constraints without losing linguistic focus. A useful planning question is therefore not simply "How can children move?" but "How does this movement help represent, reinforce, or retrieve the target language?"

A further implication concerns the type of language outcome studied. Most available evidence concerns concrete vocabulary and immediate or short-delay recall. Much less is known about broader language proficiency, morphosyntactic development, spontaneous oral production, or transfer over longer periods. The field would benefit from longer interventions, clearer outcome hierarchies, and preschool studies that compare different ways of embodying language rather than simply contrasting activity with inactivity.

Future research should distinguish more clearly between classical TPR, gesture-enriched instruction, and broader, integrated, movement-based interventions, as these labels are often used interchangeably despite involving distinct pedagogical mechanisms. Stronger preschool trials are needed with clearer reporting of dosage, teacher training, implementation fidelity, and delayed outcome assessment. It would also be valuable to compare receptive vocabulary, productive vocabulary, enjoyment, on-task behavior, and transfer outcomes within the same study, because these outcomes may not respond in the same way. Another priority is to test whether embodied instruction is differentially effective for action words, nouns, routines, and more abstract vocabulary. Such refinements help move the field beyond the broad claim that movement helps learning toward a more specific account of when, why, and for whom movement-based foreign-language teaching is most effective.

Another issue concerns dosage and recurrence. Several preschool studies relied on brief interventions or relatively small sets of lexical items, making it difficult to infer how movement-based instruction functions within a broader language curriculum. In authentic preschool practice, learning usually depends on repeated exposure across routines, songs, transitions, stories, and play episodes rather than on a single isolated lesson. Future trials should therefore examine whether embodied language teaching remains effective when vocabulary is revisited across multiple classroom contexts, whether benefits generalize from receptive recognition to more spontaneous language use, and whether child characteristics such as baseline language ability, attentional control, or motor confidence moderate the effects. Answering these questions would help translate promising experimental findings into durable classroom practice. They would also clarify whether embodied methods are best used as a core instructional routine, a supplementary reinforcement strategy, or a bridge between language and movement curricula.

## Limitations of the study

This review has several limitations. First, the direct evidence base of preschool is still small, which limits generalization. Second, the studies are heterogeneous in terms of intervention format, outcome measures, and methodological rigor, which precluded meta-analysis. Third, several preschool TPR studies relied on descriptive or uncontrolled designs, so their positive classroom findings should not be overinterpreted as causal evidence. Fourth, the literature is dominated by concrete vocabulary tasks, leaving more complex language outcomes underexplored. Finally, although the search was updated and strengthened through citation tracking, focused review methods cannot eliminate the possibility that some relevant studies were missed.

## CONCLUSIONS

Movement-based instruction can support preschool foreign-language learning, especially when children physically enact the meaning of the target vocabulary or participate in active lessons in which movement is integral to the language task. The strongest evidence currently concerns vocabulary learning and related memory outcomes. TPR remains a valuable and engaging preschool pedagogy, but the quality of available TPR evidence remains uneven. Future research should prioritize larger preschool trials, longer follow-up periods, and outcome measures that extend beyond immediate vocabulary recall.


## ACKNOWLEDGMENTS

The authors thank the reviewers for their valuable feedback.


## AI DISCLOSURE STATEMENT

During the preparation of this manuscript, the authors used DeepL Translate and Grammarly to support translation, grammar checking, and language refinement. All generated outputs were carefully reviewed and edited by the authors to ensure accuracy, clarity, and adherence to academic standards. The authors take full responsibility for the content of this manuscript.

## DATA AVAILABILITY

All data used in this study were obtained from previously published studies identified through systematic database searches. The list of included articles and relevant extracted data is available within the manuscript.


## FUNDING

No external financial support was received for the conduct of this research.


## CONFLICT OF INTEREST

The author declares no conflict of interest.

## PUBLISHER'S NOTE

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