

EXPLORING THE IMPACT OF GESTURE-BASED PHONICS INSTRUCTION ON EARLY LITERACY SKILLS IN EARLY CHILDHOOD EDUCATION CLASSROOMS

¹ABUSOMWAN, Titilayo M.

Institute of Education, University of Benin, Nigeria

titilayo.abusomwan@uniben.edu

²ANOMA, Sylvester Ugochukwu

Early Childhood Education Unit, Department of Social Science Education,
University of Lagos

Abstract

Persistent challenges in early literacy outcomes and declining learner engagement under predominantly visual-auditory phonics instruction have prompted renewed interest in developmentally appropriate, multisensory approaches to reading instruction. This study examined the effect of Gesture-Based Phonics instruction on phonemic awareness, decoding, reading comprehension, and learner engagement among early childhood learners, integrating Montessori-aligned sensory principles. A quasi-experimental pretest-posttest control group design was employed. The population consisted of kindergarten learners in early childhood education classrooms. A total of 150 learners aged 5-6 years participated, with 75 assigned to the Gesture-Based Phonics (GBP) group and 75 to the Traditional Phonics (TP) group across a 12-week intervention. Data were collected using a phonics achievement test validated by a phonics specialist, with a Cronbach Alpha score of 0.89, alongside learner engagement surveys and structured teacher observation rubrics. Results indicated that learners in the GBP group achieved significantly greater gains in phonemic awareness, decoding skills, reading comprehension, and engagement levels compared to those receiving Traditional Phonics instruction. The study recommends embedding gesture-based phonics strategies into core early literacy curricula, strengthening teacher professional development, encouraging parent-supported home-based phonics activities, and advancing longitudinal research on embodied phonics approaches across diverse educational contexts.

Keywords: Synthetic Phonics, Gesture-Based Phonics, Early Literacy, Embodied Learning, Jolly Phonics

Introduction

Learning to read is one of the most important milestones in a child's early education, and at the heart of this journey is phonics. Phonics instruction teaches children how letters and sounds work together to form words. Traditionally, this instruction has focused on what children see and hear: looking at letters, listening to sounds, and connecting the two. However, for many young learners, especially those just starting out, this can feel abstract or even difficult to grasp. Gesture-based phonics instruction offers a more engaging and hands-on way to learn. By introducing physical movement such as hand gestures, body motions, and other kinesthetic actions, children are able to connect sounds with movement. These gestures serve as memory tools that help make the learning process more meaningful. In addition to supporting phonemic awareness and decoding skills, movement can make literacy lessons more interactive, enjoyable, and accessible. This study explores the impact of gesture-based phonics instruction on early literacy development. It focuses on four key areas: phonemic awareness, decoding, reading comprehension, and learner engagement. The approach combines elements from Montessori education, such as storytelling, movement activities, and tactile learning tools, with systematic phonics instruction inspired by the works of Abusomwan et al.(2019) and Lloyd and Wernham (2020). This creates a balanced approach that values both structure and creativity in early literacy instruction. The study involves 150 children between the ages of five and six, drawn from a variety of early childhood education settings. Over a 12-week period, one group will take part in the Gesture-Based Phonics (GBP) program. A comparison group will continue with traditional phonics instruction. The goal is to observe how the two groups progress in their literacy development and how engaged they feel during their learning experiences.

Through this research, we aim to highlight the benefits of integrating movement and sensory activities into early reading instruction. By making learning more physical and interactive, children may not only develop stronger reading skills but also build a more joyful and lasting relationship with language learning.

Phonics instruction, which teaches the relationship between sounds and letters to support reading, has evolved considerably over the past century, influenced by educational philosophies, research findings, and national policies. The National Policy on Education (FGN, 2013) highlights the role of alphabet recognition and play in early literacy development. While it does not prescribe specific instructional methods such as phonics, it encourages pedagogical strategies that engage young learners through letters, sounds, and interactive activities such as play. Early methods, such as analytic phonics, encouraged learners to identify sounds within whole words. For example, teachers might ask children to notice the /k/ sound in cat associated with the letter c (Moats, 2020). This approach, often integrated with whole-language methods, emphasised reading for meaning and relied on memorisation and contextual clues rather than explicit decoding. While analytically appealing, these strategies frequently left behind learners needing more direct instruction in phonemic awareness and decoding (Adoniou et. al., 2018).

During the 1980s and 1990s, the whole language movement emphasised reading as a natural process, prioritising storytelling, literature immersion, and print-rich experiences. Consequently, systematic phonics instruction was often reduced or eliminated. This shift posed challenges for learners, particularly those with dyslexia or language difficulties, who struggled to develop foundational decoding skills (Seidenberg, 2017). Empirical evidence highlighted that literacy acquisition is not entirely automatic; rather, it requires targeted instruction to connect sounds and letters systematically.

In response, structured, explicit phonics instruction became a policy and pedagogical priority. Reports such as the National Reading Panel (2000) and the Rose Report (2006) recommended systematic teaching of phonemic awareness and decoding. Synthetic phonics emerged as a leading method, introducing phonemes individually and then teaching children to blend them into words. For example, learners are taught to blend /c/, /a/, and /t/ to read cat, supported by visual cues, actions, and manipulatives (Abusomwan et al., 2019; Lloyd & Wernham, 2020). Programmes such as Jolly Phonics, Beyond the Jolly Way Phonics, and Letters and Sounds demonstrate synthetic phonics' cumulative structure, which enhances learners' decoding skills, reading confidence, and literacy outcomes (Rose, 2006; Lerner & Lonigan, 2015; Castles et. al., 2018; Buckingham, 2020; Ehri, 2022).

Despite its effectiveness, recent research emphasises multisensory and embodied approaches that integrate physical movement and tactile experiences into phonics instruction. Given the NPE's focus on letters and play, gesture-based phonics aligns naturally with policy objectives by combining letter-sound instruction with multisensory, play-oriented movements, thereby enhancing engagement and literacy outcomes (FGN, 2013). Studies in cognitive science and neuroscience also indicate that gestures and kinesthetic activities improve memory, attention, and brain activation during learning (Mayer, 2020; Zuk et al., 2020; Glenberg et al., 2021). Gesture-based phonics instruction operationalises this principle by linking phonemes with specific movements. For instance, children might move their hand like a snake to represent the /s/ sound or perform a kicking motion for /k/. Such gestures transform abstract phonemes into concrete experiences, activating sensorimotor pathways that reinforce phonemic awareness and decoding. Additionally, movement-based storytelling or tracing letters in sand enhances learning by combining visual, auditory, and kinesthetic modalities, fostering deeper engagement and retention.

The embodied cognition framework underpins this approach, positing that cognitive processing emerges through bodily interactions with the environment (Cook et al., 2008; Goldin-Meadow, 2014; Mayer & Fiorella, 2021; Barsalou, 2023). In literacy contexts, gestures and manipulations are not peripheral but central to internalising phoneme-grapheme correspondences. By physically enacting letter sounds, learners consolidate abstract auditory information with visual and motor representations, strengthening memory and understanding. Complementing this, Montessori pedagogy emphasises child-led, sensory-rich, and movement-integrated learning environments (Montessori, 1912; Lillard, 2019; Randolph et. al., 2023). Practical tools, such as sandpaper letters, tracing trays, and alphabet manipulatives, allow children to see, feel, and act upon letter-sound correspondences. When learners trace the letter m with their finger while vocalising /m/, they simultaneously engage tactile, visual, and auditory channels. These practices promote concentration, independence, and

intrinsic motivation, aligning with developmental appropriateness for early learners. In essence, combining gesture-based phonics with Montessori-inspired tactile experiences bridges the gap between structured phonics instruction and active, multisensory learning. Children not only acquire phonemic awareness and decoding skills but also develop sustained engagement, enjoyment, and confidence in early literacy. The integration of embodied cognition and Montessori principles provides a robust theoretical and practical foundation for this study, offering both a rationale and evidence-based strategy for implementing gesture-enhanced phonics instruction in early childhood classrooms.

Research Objectives

The study aims to:

- i. Examine the relative effects of gesture-based phonics instruction and traditional phonics on phonemic awareness in early childhood learners.
- ii. Investigate the relative influences of gesture-based phonics and traditional phonics instructions on decoding and reading comprehension in early childhood learners.
- iii. determine the extent to which gesture-based phonics is different from traditional phonics instructions on learners' engagement and motivation in early literacy sessions.

Research Questions

In line with the research objectives, the following research question will guide the study.

- i. To what extent is gesture-based phonics instruction different from traditional phonics instruction in their impacts on learner engagement and motivation in early literacy sessions?

Hypotheses

The following hypotheses were tested:

H01: There is no significant difference in phonemic awareness between learners exposed to Gesture-Based Phonics (GBP) and traditional phonics (TP) instructions.

H02: There is no significant difference in the decoding and reading comprehension scores of children taught using gesture-based phonics instruction and those taught with traditional phonics instruction.

Methodology

This study adopted a quasi-experimental, pretest-posttest control group design to examine the effects of gesture-based phonics instruction on early childhood learners. This design allowed for a direct comparison between learners exposed to gesture-enhanced instruction and those receiving traditional phonics. The study involved 150 kindergarten children aged 5-6 years from three schools in Edo State. Schools were purposively selected based on demographic similarities and prior engagement with phonics programmes. Participants were randomly assigned to either the Gesture-Based Phonics (GBP) group ($n = 75$) or the Traditional Phonics (TP) group ($n = 75$). In the Gesture-Based Phonics (GBP) group, learners received instruction integrating coordinated gestures (e.g., kicking motion for /k/, turning head for /t/) representing phonemes, alongside Montessori-aligned materials such as sandpaper letters, tracing trays, and alphabet manipulatives. Lessons followed a synthetic phonics sequence (Abusomwan et al., 2019; Lloyd & Wernham, 2020), with gestures reinforcing sound-symbol connections and engaging embodied cognition pathways. While learners in the Traditional Phonics (TP) group received standard phonics instruction using visual and auditory methods, including flashcards, oral repetition, and workbook exercises, without kinesthetic reinforcement.

Both groups were taught three times per week over 12 weeks, covering the same phoneme sets within a synthetic phonics framework using: (i) Phonemic Awareness Test (PAT), which assessed children's ability to isolate and manipulate individual phonemes. (ii) Decoding Skills Assessment (DSA), which evaluated blending of phonemes and decoding unfamiliar words. (iii) Reading Comprehension Test (RCT) that measured understanding of age-appropriate passages. (iv) Learner Engagement Survey (LES) was used to capture learner attention, motivation, and participation through self-report and teacher input. (v) Teacher Observation Rubric was finally used to structure observations of engagement behaviours, participation, and enthusiasm. All instruments underwent reliability checks: PAT ($\alpha = .89$), DSA ($\alpha = .86$), RCT ($\alpha = .88$), LES ($\alpha = .84$), and

Teacher Observation Rubric (Cohen's $\kappa = .81$). Instruments were piloted in comparable early childhood settings to ensure cultural and developmental appropriateness.

Results

Paired sample t-tests were conducted to compare pre- and post-test scores between the Gesture-Based Phonics (GBP) and Traditional Phonics (TP) groups. Results consistently showed that learners in the GBP group outperformed those in the TP group across all literacy domains. There is no significant difference in phonemic awareness between learners exposed to Gesture-Based Phonics (GBP) and traditional phonics (TP) instructions.

Table 1. Paired t-Test Results for Phonemic Awareness Scores

Group	Pre-test M (SD)	Post-test M (SD)	T	df	P
GBP	68.5 (5.9)	85.4 (6.1)	14.32	74	< .001
TP	68.1 (6.2)	78.2 (7.5)	9.24	74	< .001

Both instructional approaches improved learners' phonemic awareness. However, the GBP group showed significantly greater gains, illustrating the cognitive and pedagogical value of multisensory, embodied learning. For example, learners associated the /s/ sound with a slithering hand gesture, while the /k/ sound was reinforced with a kicking motion. These gestures, combined with tactile Montessori materials such as sandpaper letters and tracing trays, strengthened the link between sound, symbol, and movement, supporting both memory and active engagement (Abusomwan et al., 2019; Lloyd & Wernham, 2020).

There is no significant difference in the decoding and reading comprehension scores of children taught using gesture-based phonics instruction and those taught with traditional phonics instruction.

Table 2. Paired t-Test Results for Decoding Skills and Reading Comprehension

Group	Measure	Pre-test M (SD)	Post-test M (SD)	Mean Gain	t	df	p
GBP	Decoding Skills	65.3 (6.4)	83.7 (6.0)	+18.4	13.45	74	< .001
GBP	Reading Comprehension	64.7 (7.1)	82.1 (6.5)	+17.4	12.82	74	< .001
TP	Decoding Skills	65.0 (6.2)	76.2 (7.4)	+11.2	8.15	74	< .001
TP	Reading Comprehension	64.5 (6.8)	74.1 (7.7)	+9.6	7.92	74	< .001

The GBP group achieved larger gains in decoding and comprehension compared to TP learners. Gesture-based activities, such as blending sounds while tracing letters or performing movement sequences for words, allowed learners to internalize phoneme-grapheme relationships more effectively. These strategies illustrate how embodied actions can enhance cognitive processing and reinforce the stepwise synthetic phonics sequence. The extent to which gesture-based phonics is different from traditional phonics instructions on learners' engagement and motivation in early literacy sessions.

Table 3. Paired t-Test Results for Learner Engagement and Motivation

Group Measure			Pre-test (SD)	M Post-test (SD)	M Mean Gain	T	df	p
GBP	Learner Survey	Engagement	65.5 (6.3)	82.8 (5.9)	+17.3	11.92	74	<.001
GBP	Teacher Rubric	Observation	66.1 (7.0)	83.2 (6.4)	+17.1	11.47	74	<.001
TP	Learner Survey	Engagement	64.8 (6.5)	75.0 (6.9)	+10.2	7.86	74	<.001
TP	Teacher Rubric	Observation	65.2 (6.8)	74.9 (7.1)	+9.7	7.35	74	<.001

Gesture-based phonics instruction significantly enhanced engagement and motivation. Learners participated more actively in storytelling, traced letters while performing corresponding gestures, and used tactile materials in combination with movement. These hands-on, multisensory experiences are consistent with Montessori principles, which emphasize child-led, sensory-rich learning, and demonstrate the benefits of embodied cognition in early literacy development (Montessori, 1912; Mayer & Fiorella, 2021). Across all measures: phonemic awareness, decoding, reading comprehension, and engagement, the GBP group showed superior outcomes compared to TP learners. Practical classroom examples, including performing gestures for sounds and blending phonemes through movement, highlight how multisensory, embodied approaches grounded in Montessori principles can enhance early literacy acquisition more effectively than traditional phonics instruction alone.

Discussion of Findings

The primary aim of this study was to examine the effect of Gesture-Based Phonics (GBP) instruction on early literacy outcomes, including phonemic awareness, decoding, reading comprehension, and learner engagement, among kindergarten children. Results from the paired sample t-tests consistently indicated that learners in the GBP group significantly outperformed their peers in the Traditional Phonics (TP) group across all measured domains.

Hypothesis 1 examined whether there was a significant difference in phonemic awareness between learners exposed to GBP and TP instruction. As presented in Table 1, GBP learners achieved a pre–post gain of 16.9 points compared to a gain of 10.1 points in the TP group ($t = 14.32$, $df = 74$, $p < .001$). These results suggest that incorporating coordinated gestures for each phoneme, alongside Montessori-aligned materials such as sandpaper letters, tracing trays, and alphabet manipulatives, enhanced learners' ability to isolate, identify, and manipulate individual sounds. For instance, learners traced the letter “s” while simultaneously performing a

“snake-like” hand motion, facilitating the internalisation of the /s/ phoneme through both visual and kinesthetic channels. These findings are consistent with the work of Cook *et al.* (2008) and Macedonia and Repetto (2017), who reported that gestures paired with linguistic concepts reinforce memory retention and cognitive processing. Similarly, Goldin-Meadow (2014) emphasises that gestures function as cognitive tools, supporting the learning of abstract concepts and deeper engagement. The observed improvements in the GBP group also align with Montessori principles, which advocate for sensory-rich, hands-on learning to foster concentration, independence, and meaningful exploration (Montessori, 1912; Lillard, 2019). The larger effect observed in this study compared to conventional synthetic phonics programmes may be attributed to the multimodal, embodied approach that engages motor and sensory pathways, rather than relying solely on visual and auditory instruction. Hypothesis 2 addressed differences in decoding skills and reading comprehension between GBP and TP learners. As shown in Table 2, GBP learners exhibited mean gains of 18.4 points in decoding and 17.4 points in reading comprehension, compared to gains of 11.2 and 9.6 points, respectively, in the TP group (t -values = 13.45 and 12.82, $df = 74$, $p < .001$). These results indicate that the systematic integration of synthetic phonics sequencing (Abusomwan *et al.*, 2019; Lloyd & Wernham, 2020) with movement-based gestures strengthens learners' phoneme-grapheme correspondence and promotes more accurate word decoding. The superior outcomes for the GBP group corroborate findings from Ehri (2022) and Buckingham (2020), who note that structured, cumulative phonics instruction enhances reading accuracy. However, this study extends previous research by demonstrating that the addition of gestures and multisensory experiences can amplify these gains. While some prior studies of traditional phonics report modest improvements in decoding, the present study highlights that learners benefit more when instruction engages multiple sensory channels and aligns with developmental needs (Seidenberg, 2017). For example, during reading activities, children in the GBP group physically acted out the blending of /c/, /a/, and /t/ to read “cat,” linking motor activity with phonological processing and enhancing retention.

Hypothesis 3 examined the impact of GBP and TP instructions on learner engagement and motivation. Table 3 shows that GBP learners experienced mean gains of 17.3 and 17.1 points on the Learner Engagement Survey and Teacher Observation Rubric, respectively, compared to 10.2 and 9.7 points in the TP group (t -values = 11.92 and 11.47, $df = 74$, $p < .001$). Observational data indicated that learners in the GBP group were more attentive, participated more actively in storytelling and tracing activities, and displayed enthusiasm for learning. These findings support prior research on the cognitive and motivational benefits of embodied learning. Goldin-Meadow (2014) and Macedonia and Repetto (2017) highlight that gestures facilitate deeper cognitive processing while sustaining learner interest. Montessori-aligned activities, such as tactile tracing of letters or kinesthetic storytelling, further reinforced engagement by allowing learners to explore concepts independently, in ways that are meaningful and enjoyable. The combination of movement, sensory tools, and systematic phonics created an environment in which learners were cognitively and physically invested in their learning, providing evidence that engagement can be enhanced through embodied, multisensory strategies.

Conclusion

In summary, this study demonstrates that gesture-based phonics instruction, which offers a developmentally responsive and evidence-based approach to early literacy instruction, yields significantly stronger outcomes in phonemic awareness, decoding, reading comprehension, and learner engagement than traditional phonics methods. By integrating structured synthetic phonics with purposeful gestures and sensory-rich materials, the intervention aligns with the principles of embodied cognition, which emphasise the role of bodily movement and sensory experience in cognitive development (Mayer & Fiorella, 2021; Barsalou, 2023), as well as Montessori's emphasis on child-centred, hands-on learning environments that foster independence and active engagement. The structured phoneme-grapheme progression provided by the synthetic phonics frameworks of Abusomwan *et al.* (2019) and Lloyd and Wernham (2020), when combined with gestures and tactile tools, created a balanced instructional approach that was both systematic and interactive.

The physical actions associated with each phoneme functioned as cognitive anchors, enhancing memory retention, conceptual understanding, and motivation, including for learners who typically struggle with conventional, predominantly visual-auditory phonics instruction. Differences between the present findings and

some prior research on traditional synthetic phonics may be attributed to the limited use of multisensory and kinesthetic strategies in conventional approaches, which often underutilise learners' embodied and affective capacities. By contrast, the gesture-based approach engaged multiple sensory pathways, supporting both cognitive and motivational dimensions of learning and contributing to a pedagogical shift toward embodied literacy instruction that supports the whole child. While the findings provide strong empirical support for integrating gesture-based phonics into early childhood classrooms, future research should examine long-term retention, scalability, and application across diverse educational contexts to further inform curriculum design and policy in early childhood literacy education.

Recommendations

Based on these findings, the following recommendations are made.

1. **Integrate Gesture-Based Phonics into Core Literacy Instruction**

Early childhood educators should adopt gesture-based strategies with traditional phonics methods. By pairing phonemes with meaningful physical movements, teachers can enhance students' engagement, memory retention, and decoding accuracy.

2. **Provide Professional Development for Teachers**

Training programs should equip educators with the knowledge and skills needed to incorporate gestures effectively into phonics instruction. Emphasis should be placed on the cognitive benefits of embodied learning and alignment with both Montessori and synthetic phonics practices.

3. **Utilise Multisensory Approaches to Support Diverse Learners**

Gesture-based instruction should be emphasised particularly for students with learning difficulties, English language learners, and kinesthetic learners. It enables differentiated instruction and promotes inclusive, student-centred learning environments.

4. **Encourage Parental Involvement Using Gestures at Home**

Educators should engage parents and caregivers by sharing gesture-based phonics techniques that can be used in home settings. Activities that incorporate movement and phoneme practice help reinforce classroom learning and strengthen home-school connections.

5. **Incorporate Ongoing Assessment and Observation**

Formative assessments and structured teacher observations should be used to monitor student progress and adapt instruction as needed. Tracking engagement and literacy development allows for continuous refinement of gesture-based strategies.

6. **Support Further Research and Longitudinal Studies**

Future studies should investigate the long-term effects of gesture-based phonics instruction on reading fluency, comprehension, and writing development. Research should also explore its scalability across different educational models and cultural contexts.

By embracing multisensory, movement-rich approaches rooted in developmental theory and structured phonics methodology, educators can transform early literacy instruction into a more engaging, inclusive, and effective learning experience.

References

- Abusomwan, T. M. W., Irosa, D.K., & Wilson, E.K. (2019). Beyond the Jollyway Phonics Course Book: Kindergarten series. DIMAF.
- Adams, M. J. (1990). Beginning to read: Thinking and learning about print. MIT Press.
- Adoniou, M., Cambourne, B., & Ewing, R. (2018). What are 'decodable readers' and do they work? *The Conversation*. Retrieved from <https://theconversation.com/what-are-decodable-readers-and-do-they-work-106067>
- Aluko, K. & Adodo, S.M. (2011). A Conceptual Analysis of School Sports Development in Nigeria, *African Research Review*, Vol. 5(5). DOI: [10.4314/afrr.v5i5.31](https://doi.org/10.4314/afrr.v5i5.31)
- Barsalou, L. W. (2023). Implications of Grounded Cognition for Conceptual Processing Across Cultures. *Topics in Cognitive Science* 15, 648–656. [Implications of Grounded Cognition for Conceptual Processing](#)

[Across Cultures - Barsalou - 2023 - Topics in Cognitive Science - Wiley Online Library](#)

- Castles, A., Rastle, K., & Nation, K. (2018). Ending the Reading Wars: Reading Acquisition from Novice to Expert. *Psychological Science in the Public Interest*, 19(1), 5–51.
<https://doi.org/10.1177/1529100618772271>
- Cook, S. W., Mitchell, Z., & Goldin-Meadow, S. (2008). Gesturing makes learning last. *Cognition*, 106(2), 1047–1058.<https://doi.org/10.1016/j.cognition.2007.04.010>
- Ehri, L. C. (2022). What Teachers Need to Know and Do to Teach Letter–Sounds, Phonemic Awareness, Word Reading, and Phonics *The Reading Teacher* [Volume 76\(1\)](#) 53-61 <https://doi.org/10.1002/trtr.2095>
- Federal Republic of Nigeria. (2013). *National policy on education* (6th ed.). NERDC.
<https://www.nerdc.gov.ng>
- Glenberg, A. M. (2021). Embodiment and learning of abstract concepts (such as algebraic topology and regression to the mean). *Psychological Research*, 86(8), Article 2398.<https://doi.org/10.1007/s00426-021-01576-5>
- Goldin-Meadow, S. (2011). Learning through gesture. *Wiley Interdisciplinary Reviews: Cognitive Science*, 2(6), 595–607.<https://doi.org/10.1002/wcs.132>
- Lerner, M. D., & Lonigan, C. J. (2015). Bidirectional relations between phonological awareness and letter knowledge in preschool revisited: A growth curve analysis of the relation between two code-related skills. *Journal of Experimental Child Psychology*, 144, 166–183.<https://doi.org/10.1016/j.jecp.2015.09.023>
- Lillard, A.S. (2019). Shunned and Admired: Montessori, Self-Determination, and a Case for Radical School Reform. *Educational Psychology Review* 31, 939–965. <https://doi.org/10.1007/s10648-019-09483-3>
- Lloyd, S., & Wernham, S. (2020). *Jolly Phonics Workbooks 1–7: In print letters (Revised ed.)* [American English ed.]. Jolly Learning Ltd.
- Macedonia, M., & Repetto, C. (2017). Embodied cognition and language learning: Evidence from gesture and enactment in second language acquisition. *Mind, Brain, and Education*, 11(1), 1–9.
- Marshall, C. Montessori education: a review of the evidence base. *npj Science Learn* 2, 11 (2017).
<https://doi.org/10.1038/s41539-017-0012-7>
- Mayer, R. E., & Fiorella, L. (2021). Introduction to Multimedia Learning. In R. E. Mayer & L. Fiorella (Eds.), *The Cambridge Handbook of Multimedia Learning* (pp. 3–16). chapter, Cambridge: Cambridge University Press.<https://www.cambridge.org/core/terms>. <https://doi.org/10.1017/9781108894333.003>
- Moats, L. C. (2020). *Teaching reading is rocket science: What expert teachers of reading should know and be able to do*. American Federation of Teachers.
<https://www.aft.org/sites/default/files/moats.pdf>
- Montessori, M. (1912). *The Montessori method: Scientific pedagogy as applied to child education in "The Children's Houses"*. Frederick A. Stokes Company. [The Montessori Method by Maria Montessori | Project Gutenberg](#)
- National Institute of Child Health and Human Development. (2000).** *Report of the National Reading Panel: Teaching children to read: An evidence-based assessment of the scientific research literature on reading and its implications for reading instruction* (NIH Publication No. 00-4769). U.S. Government Printing Office.
<https://www.nichd.nih.gov/publications/pubs/nrp/smallbook>
- National Reading Panel. (2000). Teaching children to read: An evidence-based assessment of the scientific research literature on reading and its implications for reading instruction. U.S. Department of Health and Human Services.
- Randolph, J.J., Bryson, A., Menon, L., Henderson, D.K., Kureethara, Manuel, A., Michaels, S., rosenstein, d. l. w., McPherson, W., O'Grady, R., & Lillard, A. S. (2023). Montessori education's impact on academic and nonacademic outcomes: A systematic review. *Campbell Systematic Reviews*, 19, e1330.
<https://doi.org/10.1002/cl2.1330>
- Repetto C., Pedrolí E., Macedonia M. (2017). Enrichment Effects of Gestures and Pictures on Abstract Words in a Second Language. *Frontiers in Psychology* 8
<https://www.frontiersin.org/journals/psychology/articles/10.3389/fpsyg.2017.02136>
- Rose, J. (2006). Independent review of the teaching of early reading: Final report (DfES Report

No. 1441). London: Department for Education and Skills.

<https://dera.ioe.ac.uk/5551/2/report.pdf>

Seidenberg, M. S. (2017). *Language at the speed of sight: How We Read, Why So Many Can't, and What Can Be Done About It*. Basic Books.

Skulmowski, A., & Rey, G. D. (2018). Embodied learning: Introducing a taxonomy based on bodily engagement and task integration. *Cognitive Research: Principles and Implications*, 3, Article 6. <https://doi.org/10.1186/s41235-018-0092-9>

Ugorji, C. U. C. (2010). An articulatory–perceptual approach to the teaching of pronunciation to L2 learners. *Journal of the Linguistic Association of Nigeria*, 13(1), 193–209.

[-An ArticulatoryPerceptual Approach to the Teaching of Pronunciation to L2 Learners](#)

Zuk, J., Yu, X., Sanfilippo, J., Figuccio, M. J., Dunstan, J., Carruthers, C., Sideridis, G., Turesky, T.K., Gagoski, B., Grant, P. E., Gaab, N. (2021). White matter in infancy is prospectively associated with language outcomes in kindergarten. *Developmental cognitive neuroscience*, 50, 100973.

<https://doi.org/10.1016/j.dcn.2021.100973>