Beyond Cliche: Enhancing Language Acquisition and Cognitive Development in Kindergarteners through a Synergistic Curriculum

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ABSTRACT

A novel pedagogical approach was investigated to simultaneously enhance English language proficiency and executive function in kindergarten children. A synergistic curriculum, titled "Beyond Cliche," was implemented, wherein challenging language instruction was intentionally alternated with engaging, game-like cognitive tasks. A pre-test and post-test intervention design involving 37 kindergarten children was conducted to evaluate the efficacy of this dual approach. The quantitative results demonstrated significant program effectiveness in linguistic domains, as determined by paired samples t-tests. Marked improvement was observed in both vocabulary knowledge and the correct application of Subject-Verb Agreement (SVA) rules following program participation. The hypothesized link between cognitive skills and learning acquisition was substantiated through Pearson correlation analysis. A strong association was identified between cognitive efficiency, measured by quick and proficient completion of cognitive control tasks, and the magnitude of gains in English grammar (SVA). The mechanism supporting the program's success was illuminated by qualitative feedback, which reported participant enjoyment and appreciation for the cognitive games. These activities served as a welcome, interesting break from more demanding language practice. Sustained engagement was deemed critical to the observed academic gains. The conclusion is drawn that blending language instruction with dedicated cognitive exercises creates a resilient and supportive learning environment, confirming that enhanced core thinking skills are intrinsically linked to accelerating language acquisition in young learners.

Keywords: synergistic curriculum, cognitive development, language acquisition, executive function, verbal fluency, inhibitory control

INTRODUCTION

For the past decades, it has been widely known that the preschool years are among the most crucial stages for children's growth. Such importance is notable in their cognitive development and language abilities. During this period, children are likely to learn new words faster, enhance their grammatical knowledge and develop communication skills. Surakka et al. (2025) posit that children's brains have started to grow in multiple significant areas during this phase, namely attention, memorisation, and self-control. These forms of progress are very much needed, especially to ensure that these kindergarteners have a solid foundation to succeed in primary school and, most importantly, in social interaction. To illustrate, when children manage to develop good attention skills alongside robust memory during the preschool period, they have a higher tendency to perform well in primary level, particularly in problem-solving, critical thinking, reading and other forms of instructional tasks that will influence their academic success. Therefore, this suggests that preschool education is essential for developing both language skills and supporting their cognitive abilities as they grow.

In this case, it is notable that these two components, which are language and cognition, are closely related. According to Alex et al. (2023), language is used by children to facilitate their abilities in verbalising their thoughts and ideas; on the other hand, thinking skills such as attention and memory are needed to effectively help them in comprehending and using the language in their daily lives. This is because, when one area is being strengthened, the other will likely be improved; hence, indicating that more initiatives for young children are required to help them in developing both language and cognition simultaneously. A recent global study by Bergelson et al. (2024) noted that children who have better exposure to adult speech have significantly proven to showcase better and stronger growth in their language capabilities. Correspondingly, a study by Surakka et al. (2025) pointed out that children's early cognitive abilities, like short-term memory and attention play such an important indicator for their success much later in primary school. When these two findings are viewed together, they clearly indicate that language and cognition should be perceived under one lens, and not as separate entities, as they complement each other primarily during the first few years of early childhood education.

The above-mentioned perspectives are very much relevant within the Malaysian context because the same needs are present; however, they are accompanied by additional sets of challenges. Rahmatullah et al. (2021) reveal that the recent years have witnessed a massive expansion of preschool education; however, the majority of the kindergartens still encounter various issues in the form of variations in the quality of instruction and unequal support. This shows that some children did not obtain an equal amount of assistance, as most of them are likely to begin their primary school education at a disadvantage compared to others. Findings by Hutagalung et al. (2022) reveal that kindergarteners in Malaysia regularly show an average level of performance in terms of cognitive capabilities, regardless of being in private or public institutions. Such an outcome demonstrates that there is a need to have more well-structured and creative programs that are capable of incorporating both language and cognition. Therefore, to address the said problems, the Curious Kids Language Lab provides a two-window approach in which the first window emphasises language learning using various activities, including grammar practice and vocabulary enrichment. Meanwhile, the second window focuses on enhancing cognitive skills through attention-building exercises, memory games, alongside sequencing activities. When these two components are combined in one program, the curriculum aims to provide pre-schoolers with a better and stronger foundation, particularly in language learning and cognitive development.

Theoretical Framework

The theoretical foundation for this study curriculum rests on the Cognitive Hypothesis of Bilingualism (Bialystok, 2015), which posits that the demand for managing two linguistic systems strengthens general executive functions such as inhibitory control and cognitive flexibility. This theoretical framework provides the basis for the synergistic design: if managing two languages enhances cognition, then intentionally strengthening core cognitive skills, should, in turn, accelerate language acquisition.

The Research Gap

Numerous numbers of past studies indicate that language tasks and cognitive activities are proven to be effective; however, the majority of the said programs only emphasise one domain. For instance, findings in Bergelson et al. (2024) revealed that language growth is influenced by the children's exposure to adult speech, but this research did not highlight whether similar input will also affect the enhancement of cognitive abilities. Similarly, Surakka et al. (2025) noted that their early skills, such as memory and attention, will dictate the children's achievement later in school, yet this still does not clearly show the link between cognitive development and language acquisition. This implies that even though both domains have been investigated, there is limited evidence on the advantages of integrating language learning and cognitive skills together under one single framework. Correspondingly, a parallel situation exists in the local context of Malaysia, whereby it can be perceived that preschool curriculum focuses more on comprehensive development, but language and cognitive activities are still being taught as a different entity (Rahmatullah et al., 2021). Likewise, Hutagalung et al. (2022) reported that kindergarteners perform moderately in their cognitive abilities, be it in private or public schools. Taken together, this shows that there is a need for more integrated approaches that can enhance both domains, language and cognition, simultaneously. Therefore, the two-window approach aims to address this gap by portraying how cognitive abilities and language can be combined, side by side, through one single program.

Research Objectives

Based on these identified gaps in previous research, this study is conducted to investigate on how a two-window approach can facilitate pre-schoolers effectively. Thus, the objectives stated below are set to examine its impact as well as to discover the benefits of the combined approach in one single program:

a) To evaluate the effectiveness of a two-window approach in improving kindergarteners' language and cognitive skills.

b) To examine the synergistic benefits of combining language activities with cognitive tasks

Hypotheses

This study was guided by the following hypotheses:

a) H1 (Paired Samples t-Test): Participants who engage in the synergistic curriculum will exhibit a significant positive increase in English language proficiency scores (vocabulary knowledge and Subject-Verb agreement) from pre-test to post-test.

b) H2 (Pearson Correlation): There will be a significant statistical association between participants' enhanced cognitive capacity (as measured by verbal fluency scores and cognitive control efficiency) and their rate of English language acquisition (language change scores).

LITERATURE REVIEW

Language Acquisition in Childhood

In early childhood education, instructional lessons for language acquisition are designed grounded on the approaches that match with their developmental stage and educational requirements. Some of the most popular practices in early childhood schools include play-based learning, storytelling, singing, and Total Physical Response (TPR) (Islahuddin, 2023; Putri & Rustipa, 2023; Gumiandri, 2021). These teaching methods promote multisensory engagement, facilitate interaction, and offer significant settings for language use (Rompas & Recard, 2021; Solichah & Fardana, 2024; Fan et al., 2024). For instance, TPR connects language input to physical actions, making abstract words comprehensible through embodied learning which Asher called as "Silent period" - an observation period which they are digesting the information and imitate on what they have learned when they are ready (Asher, 1981 as cited in Xie, 2021). Meanwhile vocabulary and auditory comprehension are improved by the repetition, rhythm, and narrative structures of songs and storytelling (Cameron, 2001 as cited in Ali, 2020). Empirical evidence has demonstrated a significant positive correlation between melodic patterns and the acquisition of grammatical structures in language (Pino et al., 2023) and through dialogical learning strategies, children demonstrate the ability to engage meaningfully in learning tasks and advance their cognitive capacities in a productive way (Ghazali et al., 2024). As these teaching methods lessen fear and increase intrinsic drive to speak English, they are aligned with Krashen's (1982) emotional filter hypothesis that emphasises on the importance of lowering emotional barriers such as anxiety, self-consciousness, and lack of motivation in order to facilitate effective language acquisition to allow cognitive resources to be fully directed toward processing and internalising linguistic input.

Although the approaches used are proven effective, challenges in acquiring the English language mainly elicited from teachers and preschool learners. Insufficient teacher training and low language proficiency levels frequently undermine the quality of instruction provided to young learners (Mohamad Muar et al. 2023; Huda et al., 2022; Lotfie et al., 2022). These studies also found similar findings highlighting on the usage of mother tongue during lessons due to the teachers being less proficient, impaired learners' pronunciation and vocabulary acquisition. Transition in the English curriculum to CEFR alignment and teachers' limited understanding of the language syllabus itself have hindered the development of learners' language skills (Mohamad Muar et al. 2023). Moreover, this challenge is heightened for children who are not bilingual, particularly those who are from non-English homes and classroom instruction is the sole exposure to the English language, adding more challenge to

the teachers in providing lessons that cater to their level of proficiency. As a result, when students face difficulty in acquiring the language, they tend to disassociate themselves from the activity during the lesson (Joner et al., 2022). However, for bilingual children, they are able to grasp more vocabulary (Mangold et al. 2024) as it was found that they have greater cognitive flexibility (Ramirez & Kuhl, 2017). Despite that, when the teachers lack adequate exposure to correct pronunciation and appropriate instructional resources (Lotfie et al., 2022) causing lack of confidence in using English language in their lesson affecting the learners' acquisition. Hence, effectiveness of the structured lessons employing established approaches is determined by the teacher's ability to adapt them to the classroom context and their level of preparedness but also by children's capacity to acquire English language effectively.

The present research focuses on two key theories that support language acquisition, Piaget and Vygotsky. They provide insights into how young learners acquire language in relation to cognitive development. Piaget (1959) argued that children in the preoperational stage (ages 2–7) are developing symbolic thought, imagination, and the capacity to represent themselves through language. This stage highlights the importance of play and imaginative activities, which allow children to practice new vocabulary in authentic environments. According to Zhou (2020) mental activities of children are attained over time based on concept and depiction as they have not yet developed the ability for reversible reasoning. As Piaget highlights that children are egocentric at the beginning, lessons that incorporate interactive activities will overcome their egocentrism. In a study conducted by Rachma et al. (2024), the use of representation and symbols in pretend play has shown improvement in children's vocabulary range, expressive language and imaginative capacity which stimulate their cognitive abilities. Vygotsky (1978), on the other hand, emphasized the role of social interaction and cultural mediation in language learning. Through scaffolding provided by adults or more capable peers within the Zone of Proximal Development (ZPD), children can acquire linguistic skills beyond their independent abilities. Based on the systematic review study conducted, Ghazali et al. (2024) found that lessons that used pedagogical approach that emphasised learner-centeredness, incorporates play-based interaction within the Zone of Proximal Development (ZPD), and employs diverse interactive strategies has significant impact toward the development of language skills among kindergarteners. These theories suggest that both cognitive readiness and social interaction are integral to early language acquisition.

Therefore, by integrating the theories in early childhood education support the development of synergistic approaches. A great foundation of synergistic learning based on Piaget's focus on symbolic play together with Vygotsky's theory on scaffolding enables teachers to embed imaginative activities in structured lessons. Holistic learning through the active use of the English language helps to nurture their cognitive and socio-emotional development and contribute to their language acquisition.

Literature Review: Cognitive Behavioral Tasks for Young Children

Cognitive-behavioral tasks (CBTs) are widely recognized as effective tools for improving young children's executive function (EF), which includes attention, working memory, inhibitory control, and cognitive flexibility. These skills are essential for academic success, emotion regulation, and social interaction during early childhood. Recent innovations show how CBTs can be adapted into developmentally appropriate and engaging formats. Domenico et al. (2025), for instance, reported that virtual reality-based CBT led to significant improvements in attention, inhibitory control, and social skills for preschoolers with ADHD and ASD. Similarly, Chu et al. (2023) demonstrated that parent-facilitated digital interventions enhanced attention and cognitive flexibility in children with autism, highlighting that technology-driven CBTs can effectively combine structured therapy with play, especially in home settings. These findings suggest that CBTs are not limited to clinical environments but can be successfully integrated into children's daily lives.

Additionally, on top of digital tools, structured game-based approaches have also been shown to be effective in fostering EF skills. Gulz et al. (2020) found that preschoolers who participated in a teachable-agent game displayed developments in problem-solving, working memory, and cognitive flexibility. Adaptations such as multimodal cues and structured parental guidance strengthen these outcomes even more. It was pointed out by Li et al. (2023) that the involvement of parents, together with multisensory cues, facilitated gains in children's capacity for sustained attention and inhibitory control. Empirical support can also be found from examinations of training programs that centre on selective attention. Bulut et al. (2024) revealed that targeted EF training

significantly improved the ability of children with learning disorders to focus their attention and resist distractions. Together, these studies underscore the potential of play-based CBTs and structured cognitive interventions to substantially facilitate and enhance children's preparedness for learning.

Engaging in creative activity like the arts also serves as another approach to developing EF through CBT-based activities. A study conducted by Rodríguez-Gómez and Talero-Gutiérrez (2022) looked at how training in music greatly benefited short-term memory and self-control. Fascinatingly, what they discovered was that children involved in fine arts performed better than children involved in music training in certain EF tasks. This suggests that different types of creative involvement may trigger and operate distinct cognitive pathways in a child's mind.

Programs centered on physical activity are also consistent with CBT principles as they embed opportunities for self-regulation practice too. As explained by Capio et al. (2024), better physical competence was connected to stronger EF and improved interpersonal skills. What these findings suggest is that creative and physical activities can naturally aid CBT strategies in early developmental stages.

CBTs also show strong socio-emotional benefits, particularly in regulating emotions and reducing anxiety. Recent findings demonstrate that executive function training can bolster adaptive control, enabling children to manage inhibition and cognitive flexibility in dynamic contexts (Niebaum et al., 2019). Takahashi et al. (2023) further reported that a multimodal community-based CBT program reduced anxiety symptoms while improving problem-solving and emotional regulation in at-risk preschoolers. Beyond direct child outcomes, parental factors also play an important role. Riley et al. (2024) found that stronger maternal EF was associated with lower parenting stress and better child behavioral outcomes, suggesting that CBT-informed approaches may generate benefits that extend across family systems.

Finally, the implementation of CBTs in non-academic environments has important implications for scalability and ecological validity. Zhukova and Trent (2022) reviewed home-based adaptations of CBT and found that structured play and parent–child interaction therapy promoted emotion regulation and social skills in everyday contexts. By embedding CBT principles into family routines, children receive consistent opportunities to practice EF skills without requiring specialized resources. Collectively, the evidence highlights that CBTs—whether delivered through digital platforms, games, arts, physical activity, or caregiver-facilitated play—enhance both cognitive and socio-emotional development. The adaptability of these interventions to home and community settings ensures that they not only support children's immediate learning and regulation but also lay the foundation for long-term academic success and well-being.

METHODOLOGY

Study Design

This study adopts a pre-test and post-test design to see how the synergistic curriculum supports kindergarteners' language and cognitive growth. All participants in the program completed the same set of activities and assessments before the curriculum began (pre-test) and again after it ended (post-test). The tasks included age-appropriate language exercises, early literacy activities, and short games that assessed memory and attention. Because the participants were very young, trained facilitators worked alongside them during both testing sessions. The facilitators guided them carefully by reading instructions aloud, demonstrating practice items, and checking that the participants understood what to do, without giving away answers. This ensured that the results reflected their true abilities rather than confusion about the tasks.

Given the young age of the participants, trained facilitators were present throughout the testing sessions to provide gentle support. They read instructions aloud, demonstrated practice items, and checked for understanding to ensure each participant knew what to do, while carefully avoiding any influence on the answers. Therefore, this created a supportive environment and allowed the results to reflect the participants' genuine skills and progress.

The data analysis employed a multi-faceted approach to comprehensively evaluate the program's effectiveness

and test the synergistic hypothesis. First, the program's impact on language acquisition was assessed by comparing each participant's pre-test and post-test scores using paired samples t-tests. This method was chosen to treat each participant as their own control, enabling the researchers to isolate and measure genuine growth in vocabulary and Subject-Verb Agreement (SVA) linked directly to the curriculum intervention. Secondly, the hypothesized link between cognitive capacity and the rate of language gain was investigated using Pearson correlation analysis. This involved correlating the final performance on the cognitive tasks (Verbal Fluency score and Mean Reaction Time) with the participants' language change scores (post-test minus pre-test) to determine the statistical association between enhanced cognitive ability and greater linguistic improvement. Finally, qualitative data was collected through participant interviews and feedback sessions following the intervention. This qualitative approach was necessary to gather rich, firsthand insights into the participants' experiences, their perception of the synergistic blend of activities, and the factors contributing to their motivation and sustained engagement.

Participants and Setting

A total of 37 six-year-old kindergarten children participated in the study. This study was conducted at Tadika Taman Asuhan, University Technology MARA, Shah Alam, within a familiar and supportive context of their normal school environment. To make the activities and assessments more engaging, the participants were divided into five smaller groups. This arrangement gave them more opportunities to interact closely and receive focused guidance from facilitators. The study was integrated into their regular school day, and parental consent was obtained, making the participants' experience was both natural and comfortable.

The synergistic curriculum was carried out as a four-hour session in the participants' usual classroom. Having the program in their everyday setting helped them feel comfortable and encouraged them to take part naturally with their friends. During the activities and assessments, trained facilitators were present to offer guidance by reading instructions, demonstrating tasks, and checking understanding, while carefully avoiding any influence on the participants' responses. This supportive environment allowed the program to run smoothly and provided an accurate representation of the curriculum's potential to foster language and cognitive development in a real preschool setting.

Data Collection Instruments

English Proficiency Assessment

The English Proficiency Assessment was designed to evaluate and strengthen kindergarteners' linguistic abilities, with a particular focus on vocabulary development, grammar, and sentence construction. The assessment employed interactive, play-based tasks, reflecting research that highlights the effectiveness of task-based and playful approaches to language learning (Annamaria, 2015; Cameron, 2001).

The first task, Spot the Right Word, measured participants' ability to identify and differentiate among word classes such as nouns, verbs, and pronouns. Prior to the task, an experienced educator provided brief instruction. During the activity, children categorized individual word cards into labelled bins within a 60-second time limit, thereby reinforcing both semantic processing and syntactic awareness (Muhammad Soali et al., 2023; Ellis, 2006).

The second task, Sentence Builder Challenge, combined vocabulary and grammar practice by requiring participants to rearrange jumbled word cards into coherent sentences within a timed setting. This activity emphasized subject–verb agreement and fostered morphosyntactic awareness, a critical predictor of language proficiency and reading comprehension in young learners (Lee, Wolters, & Kim, 2022; Kuo & Anderson, 2006).

Together, these tasks created an engaging learning environment that blended play, competition, and timed performance, promoting deeper vocabulary integration and greater confidence in sentence construction. This approach is consistent with evidence from game-based language pedagogy, which supports motivation and cognitive stimulation in early language acquisition (Chowdhury et al., 2024; Zou et al., 2021).

Cognitive Skills Assessment

The Cognitive Skills Assessment targeted executive functions central to young children's cognitive development, particularly lexical retrieval, inhibitory control, and cognitive flexibility. These tasks were adapted into age-appropriate, game-like formats, consistent with research supporting structured play-based approaches to assessing cognition (Gibb et al., 2021; Zelazo et al., 2016).

The Word Explorer Challenge assessed verbal fluency and semantic retrieval by asking participants to generate as many words as possible within a semantic category (e.g., animals, food) in 60 seconds. This required rapid lexical access while exercising inhibitory control to avoid repetition, providing valuable insights into executive functioning in a motivating context (Ralli et al., 2021).

The Opposite Challenge, adapted from the NEPSY-II Inhibition subtest (Korkman, Kirk, & Kemp, 2007), measured inhibitory control and cognitive flexibility. In the baseline phase, children named simple stimuli (e.g., shapes or arrows). In the subsequent inhibition phase, they applied an "opposite rule" (e.g., responding "square" when shown a circle, or "down" when shown an upward arrow). This sensitive measure captured participants' ability to suppress prepotent responses and shift flexibly between rules (Bialystok, 2015).

Taken together, these tasks provided a comprehensive assessment of core executive functions that are crucial for school readiness and cognitive advantage (Bialystok, 2015), while maintaining an enjoyable and developmentally appropriate testing environment.

Data Analysis Plan

Quantitative data from pre- and post-tests of both the English Proficiency and Cognitive Skills Assessments were analyzed using paired sample t-tests. This method allowed each child's post-test performance to be compared against their own baseline, effectively accounting for individual variability and highlighting growth attributable to the intervention. Descriptive statistics summarized overall trends, while inferential analyses determined the significance of observed improvements.

Qualitative data, including facilitator observations and behavioral notes recorded during assessments, were analyzed thematically. The interview and feedback data were subjected to a systematic thematic analysis based on the six phases outlined by Braun and Clarke (2006). The steps included: 1) familiarization with the data (transcribing and reading the interviews); 2) generating initial codes (identifying participant expressions related to enjoyment, difficulty, and the cognitive window); 3) searching for themes (grouping related codes into broader themes like "Cognitive Relief" and "Sustained Engagement"); 4) reviewing themes; 5) defining and naming themes; and 6) producing the report. This systematic process ensured that the qualitative findings accurately represented the participants' voices and provided a comprehensive understanding of the program's perceived impact.

Product Description

The module was tailored to address two complementary windows essential for children's development: English language proficiency and cognitive control capacity. These two windows were conceptualized as two distinct yet related windows of opportunity through which the module sought to strengthen both linguistic and higher-order cognitive functioning. The foundation for this dual-focus design is the mounting evidence supporting that bilingual and cognitive skills development are mutually reinforcing, in which improvement in one area is likely to contribute to improvement in the other.

Therefore, the module was divided into two windows: the English Proficiency Window, which focused on learning and practicing elementary linguistic skills, and the Cognitive Window, which helped reinforce executive functions with directed cognitive-behavioral exercises. The module was delivered in a structured sequence to balance instruction with practice opportunities across both windows. First, the participants received instruction from an experienced educator on the first test (nouns, verbs, pronouns) before engaging in the first English Proficiency Window. Following this, the participants proceeded to the first Cognitive Window, targeting semantic retrieval. The second instructional segment was then introduced by the educator, focusing on sentence

construction principles, after which participants completed the second English Proficiency. Finally, participants advanced to the second Cognitive Window, which required inhibitory control and cognitive flexibility.

Importantly, all behavioral tasks were conducted on a one-to-one basis, as the nature of the tasks required sustained attention and minimal distraction. This individualized concept ensured that each participant could focus fully on the task at hand without interference from external factors, thereby enhancing the validity and reliability of the assessment outcomes. The following subsections describe each window at length, outlining the instructional material, activities, and pedagogical methods employed to create the intended outcomes.

English Proficiency Window

The English Proficiency Window of the module was designed to strengthen participants' linguistic skills, with particular emphasis on vocabulary development, grammatical, and sentence construction. In line with prior research highlighting the benefits of playful, task-based learning for language acquisition (Annamaria, 2015; Cameron, 2001), this window integrated interactive tasks encourage participants to actively categorize, manipulate, and apply linguistic elements in meaningful contexts.

First behavioral task, Spot the Right Word, focused on developing participant's ability to recognize and differentiate between word classes namely nouns, verbs, and pronouns. Prior to engaging in the task, participants received instruction on the use of nouns, verbs, and pronouns delivered by an experienced educator. Participants were provided with individual word cards and tasked with classifying them into labelled bins corresponding to the appropriate grammatical category within a set time limit (60 seconds). For an example, a participant who drew the word play was expected to recognize it as a verb (a "doing word"), while cat would be placed under nouns (a "naming word"), and she under pronouns (a "replacing word"). This task engaged the participants in both semantic processing and syntactic awareness, as they were required to evaluate whether a given item represented a "doing word" (verb), a "naming word" (noun), or a "replacing word" (pronoun). The categorization task not only reinforced vocabulary knowledge but also nurtured an understanding of grammatical functions within sentence structure (Muhammad Soali et al., 2023; Ellis 2006).

Secondly, the Sentence Builder Challenge was designed to integrate vocabulary and grammar in constructing correct sentences. Prior to engaging in the task, participants received instruction on the use of nouns, verbs, and pronouns delivered by an experienced educator. Participants were provided with sets of jumbled word cards containing subjects, verbs, and objects, and were instructed to rearrange them into coherent sentences with a set time limit (60 seconds). For instance, a set of cards such as *the, boy, runs,* and *fast* would initially appear disordered (e.g., "runs boy the fast"), but participant was instructed to reconstruct it into the correct form, "The boy runs fast." This task required attention to subject-verb agreement, as participants were encouraged to adjust the verb form depending on whether the subject was singular or plural. Such sentence-level construction tasks foster morphosyntactic awareness, a critical predictor of language proficiency and reading comprehension in young learners (Lee, Wolters, & Kim, 2022; Kuo & Anderson, 2006).

These tasks created a dynamic learning environment that combined elements of play, competition, and timed performance. By embedding instruction in engaging, game-like contexts, the English Proficiency Window promoted deeper vocabulary, heightened grammar, and greater confidence in sentence formation. Consistent with findings from game-based language pedagogy (Chowdhury et al. 2024; Zou et al., 2021), these tasks ensured that language learning was both cognitively stimulating and affectively supportive.

Cognitive Window

The Cognitive Window was designed to enhance and assess participants' executive functioning capacities, with a particular focus on lexical retrieval, inhibitory control, and cognitive flexibility. In line with past studies showing that structured play-based tasks can effectively measure and strengthen executive processes in early childhood (Gibb et al., 2021; Zelazo et al., 2016), this component employed interactive activities adapted into game-like formats. These tasks encouraged children to engage in rapid lexical access, response inhibition, and rule-switching, thereby creating a playful yet cognitively demanding environment.

The first behavioral task, *Word Explorer Challenge,* was developed to assess verbal fluency and sematic retrieval.

In this task, participant was presented with a semantic category (e.g., "Animals", "Food", or "Things you wear") and asked to generate as many relevant words as possible within a 60-second time limit. For example, when shown a card image of animals, participant might produce "dog", "cat", "fish", and "elephant". The task required not only lexical access but also inhibitory control to avoid repetition and invalid responses. Such semantic fluency tasks have long been established as reliable measures of verbal retrieved speed and executive function in children (Ralli et al., 2021). By embedding the task in an engaging, play-oriented context, the activity maintained high levels of motivation while eliciting valuable cognitive performance data.

Next, *Opposite Challenge*, was adapted from the NEPSY-II Inhibition subtest framework (Korkman, Kirk, & Kemp, 2007) to suit children. This task targeted children's ability to suppress automatic responses and replace them with rule-based alternatives, thereby directly engaging inhibitory control and cognitive flexibility. The task was structured in two progressive phases. In the baseline phase *(Naming)*, participant was asked to identify simple stimuli such as shapes (e.g., "circle", "square") or arrows (e.g., "up", "down"), establishing automatic naming accuracy and processing speed. For an example, when a card image of "black circle" was shown, the participant needed to respond "circle" but when a card image of "black square" was shown, the participant needed to respond "square". In the second phase *(Inhibition),* the "Say the Opposite" rule was introduced. For instance, when shown a red circle, participant was required to respond "square" and when shown a blue square, participant responded "circle". Similarly, a red upward arrow required the response "down", while a blue downward arrow required "up". This phase required participant to actively suppress the more nature, prepotent naming response in favour of the opposite rule, providing a sensitive measure of inhibitory capacity.

Together, the *Opposite Challenge* and *Word Explorer Challenge* both challenged cognitive skills from diverse perspectives. The latter required verbal fluency and semantic retrieval with time pressure, while the former tested inhibitory control, response monitoring, and flexible rule-switching. These skills are largely thought to be at the center of executive function development and have direct implications for school readiness and bilingual cognitive advantage (Bialystok, 2015). By positioning these tasks in age-specific, motivating formats, Cognitive Window balanced rigorous cognitive testing against enjoyable and supportive learning.

FINDINGS AND DISCUSSION

This section presents the findings from the Curious Kids Language Lab intervention, structured to provide a comprehensive analysis of the program's impact. The first subsection reports the results of paired samples t-tests, which were conducted to measure changes in participants' English language skills, specifically in subject-verb agreement (SVA) and vocabulary related to nouns, pronouns, and verbs. The second subsection integrates qualitative data from interviews with participants, offering valuable insights into their experiences and providing direct feedback on the program. Finally, a third subsection explores the association between cognitive control capacity, as measured by performance in the cognitive activities, and the participants' rate of understanding and grasping the English language concepts taught during the program. This combined approach of quantitative and qualitative analysis provides a holistic view of the intervention's efficacy and the nuanced relationship between cognitive skills and language acquisition.

Results from paired samples t-tests on English language skills (SVA and vocabulary)

The first phase of the quantitative analysis focused on assessing the program's impact on English language proficiency through pre- and post-intervention tests. Paired samples t-tests were conducted to measure improvements in two key areas: vocabulary and subject-verb agreement (SVA). The results consistently demonstrated significant positive changes in both skill sets.

Table 1 Paired Samples T-test for Spot the Right Word! and Sentence Builder Challenge

Variables	Pre		Post		*df*	*t*	*p*
	M	*SD*	*M*	*SD*			
Vocabulary enrichment	1.08	1.84	4.50	2.06	37	-8.44	<.001
Sentence building improvement (SVA)	0.74	1.06	4.03	1.17	37	-12.73	<.001

For the vocabulary section, which included nouns, pronouns, and verbs, the data from the 'Language Window: Spot the Right Word!' activity showed a substantial increase in participant scores. The pre-test mean score was M=1.08 (SD=1.84), which increased dramatically to a post-test mean score of M=4.50 (SD=2.06). This marked improvement confirms that the interactive teaching session was highly effective in enhancing the participants' comprehension and retention of new vocabulary.

Similarly, the 'Language Window: Sentence Builder Challenge!' activity, which focused on SVA, yielded significant findings. The pre-test mean score for SVA was M=0.74 (SD=1.06), indicating a low baseline knowledge among participants. Following the intervention, the post-test mean score rose significantly to M=4.03 (SD=1.17). This increase provides strong evidence that the program successfully improved the participants' understanding and mastery of a fundamental grammatical concept in English.

Collectively, these quantitative findings from the paired samples t-tests highlight the program's success in directly improving participants' core English language skills. The statistically significant improvements in both vocabulary and SVA align with recent research on the effectiveness of game-based learning (GBL) in second language acquisition. Studies by Rajendran et al. (2025) and Syafitri and Sujannah (2024) have found that GBL is highly effective in enhancing grammar and vocabulary acquisition by creating a more motivational and engaging learning environment. The playful and interactive nature of the Curious Kids Language Lab activities, such as matching words and building sentences, likely contributed to this success by reducing learning anxiety and increasing active participation (Hutagalung et al., 2020).

The substantial increase in vocabulary scores, in particular, supports the findings of Thompson and von Gillern (2020), who highlighted the positive impact of video games on vocabulary acquisition. The Spot the Right Word! activity, which required participants to actively engage with new words, facilitated the kind of deep processing and repetition necessary for long-term retention. Moreover, the significant improvement in SVA knowledge demonstrates that playful, game-based approaches can be effective for teaching complex grammatical concepts, not just simple lexical items (Brevik & Rindal, 2020). These results suggest that the "Curious Kids Language Lab" module provides a solid foundation for further language acquisition, paving the way for more autonomous and enjoyable learning experiences.

The Synergistic Relationship Between Cognitive and Language Development

The final component of this analysis investigates the core premise of the synergistic curriculum: the relationship between enhanced cognitive capacity and the rate of English language acquisition. As the intervention intentionally integrated cognitive tasks (verbal fluency and inhibitory control) with language instruction, it was hypothesized that participants with higher cognitive abilities, as measured post-intervention, would exhibit greater gains in language proficiency. To test this hypothesis, Pearson product-moment correlation coefficients were calculated between the post-intervention scores for the cognitive tasks and the language acquisition change scores (Post−test−Pre−test) for both vocabulary and Subject-Verb Agreement (SVA).

Verbal Fluency and Vocabulary Acquisition Rate

Table 2 Pearson Correlation between Spot the Right Word! scores and Word Explorer Challenge! scores

		Verbal Fluency scores	Vocabulary Acquisition Rate
Verbal Fluency scores	Pearson Correlation	1	-.417*
	Sig. (2-tailed)		.010
	N	37	37
Vocabulary Acquisition Rate	Pearson Correlation	-.417*	1
	Sig. (2-tailed)	.010	
	N	37	37

*. Correlation is significant at the 0.05 level (2-tailed)

The correlation analysis between the final score on the 'Word Explorer Challenge' (a measure of verbal fluency, defined as the total number of unique, correct words listed in 60 seconds) and the language acquisition change score for vocabulary demonstrated a moderate and significant negative relationship ($r(37)=-.417$, $p=.01$). This finding is contrary to the theoretical expectation of a positive correlation, which would suggest that higher fluency leads to greater gains. The observed inverse relationship suggests that participants who exhibited higher verbal fluency (listed more words) post-intervention actually achieved smaller gains in their vocabulary change scores. A plausible interpretation of this counter-intuitive result is the potential for a ceiling or floor-level effect: participants who possessed already robust baseline lexical retrieval skills (and thus scored higher on the post-test fluency task) had less capacity for score improvement on the specific vocabulary assessment. It is also possible that the fluency task, which measures word retrieval speed, is not directly coupled with the learning of the specific vocabulary items assessed in the language test. This result warrants further investigation to disentangle the relationship between innate lexical capacity and intervention-driven learning gains.

Cognitive Control and Grammatical Acquisition Rate

Table 3 Pearson Correlation between Sentence Builder Challenge! scores and Opposite Challenge! scores

		Grammatical Acquisition Rate	Cognitive Control
Grammatical Acquisition Rate	Pearson Correlation	1	-.339*
	Sig. (2-tailed)		.040
	N	37	37
Cognitive Control	Pearson Correlation	-.339*	1
	Sig. (2-tailed)	.040	
	N	37	37

*. Correlation is significant at the 0.05 level (2-tailed)

Furthermore, a Pearson correlation was conducted between the mean reaction time (RT) for correct trials on the 'Opposite Challenge' (a proxy for cognitive efficiency and inhibitory control) and the language acquisition change score for SVA. The analysis found a moderate and significant negative correlation ($r(37)=-.339$, $p=.04$). This result strongly supports the central hypothesis by confirming that participants who demonstrated higher cognitive efficiency (i.e., faster processing times, or lower RT) on the Opposite Challenge task also exhibited greater improvements in their SVA knowledge (higher change score). The inverse relationship between RT and language gain highlights the importance of rapid executive functioning in the acquisition of grammatical rules, which demands quick mental resource allocation and effective error monitoring (Churchill, 2019; Wen & Li, 2021). The synergistic curriculum successfully integrated these cognitive demands, leading to enhanced grammatical learning.

Collectively, these correlation results provide quantitative support for the study's central claim regarding the efficacy of a synergistic curriculum. The findings demonstrate that improved efficiency in core executive functions, specifically rapid inhibitory control, is directly and positively linked to enhanced learning outcomes in English grammar.

Qualitative data from participant interviews and feedback

To provide a more comprehensive understanding of the program's impact, qualitative data were collected from participant interviews and feedback sessions. While the quantitative findings revealed *what* happened in terms of score improvements, this qualitative analysis is crucial for understanding the participants' direct experiences, perceptions, and the factors that contributed to their learning. The insights gathered from these firsthand accounts offer a deeper, more nuanced perspective on the efficacy and overall success of the intervention, complementing

the statistical results and highlighting key themes that emerged from the program.

Table 4 Summary of Qualitative Feedback on Synergistic Curriculum Design

Theme	Participant Observation	Implication for Synergistic Design
High Motivation	"We had fun." / "It was interesting."	The overall experience fostered a positive affective environment conducive to learning.
Cognitive Challenge	"The language window was a bit difficult."	Participants recognized the cognitive load associated with new language acquisition.
Complementary Structure	"When we played the cognitive window after the language window, we liked it."	The alternating structure provided necessary mental breaks, preventing disengagement.
Sustained Engagement	Difficult language tasks did not feel "boring."	The inclusion of highly engaging cognitive tasks mitigated the natural boredom associated with difficulty.

Thematic analysis of the participant interviews revealed strong endorsement for the synergistic curriculum model, particularly regarding the role of the Cognitive Window in maintaining motivation and engagement. The primary theme identified was Cognitive Relief and Sustained Engagement. Participants consistently reported that although the language tasks were sometimes difficult, the cognitive games provided a necessary and enjoyable break that prevented frustration and boredom. For instance, one participant expressed the sentiment shared by many, stating, "The English words were a bit hard, but when we did the shape game, it was interesting and fun. It made me want to keep playing." Another participant echoed this complementary dynamic by noting, "I liked the animal game [Word Explorer] the most. It made my brain fast, and then I could go back and try the sentence game again." This feedback confirms the dual function of the Cognitive Window: it not only reinforced executive functions but also served as a crucial affective bridge, sustaining engagement through challenging linguistic practice and validating the emotional benefits of the synergistic design.

IMPLICATIONS

The findings of this study have important implications for curriculum planning and early childhood education. Conducting the module with 37 six-year-old children from Tadika Asuhan UiTM demonstrated that mixing English ability tasks with cognitive skills activities can yield a more balanced and effective learning activity. The findings show that language learning is not only maximized when paired with engaging, play-oriented activities, but also when it is incorporated into activities that also enhance memory, attention, and inhibitory control. From an educational curriculum perspective, this emphasizes the value of integrating a model of early education. Rather than maintaining linguistic learning and cognitive skill development as separate domains, merging them within a single framework allows children to transfer skills across domains supporting both language capacity and executive function. This approach is aligned with growing evidence that bilingual acquisition and cognitive control are mutually strengthening one another, in the sense that well-designed modules can have multiplied outcomes.

Actionable Recommendations for Stakeholders

Based on these implications, the following actionable recommendations are provided to stakeholders in early childhood education:

a) For Curriculum Developers: It is recommended that formal language acquisition programs intentionally embed dedicated, short-burst cognitive control activities (e.g., inhibitory and shifting tasks) directly into

the instructional sequence. These activities should be treated not as warm-ups but as core components designed to prime executive function for subsequent linguistic processing.

b) For Early Childhood Educators: Teachers should adopt the "Cognitive Relief" strategy by deliberately scheduling engaging cognitive games immediately following challenging language lessons. This practice is vital for mitigating cognitive fatigue, maintaining positive affect, and ensuring sustained focus, particularly during difficult grammar instruction.

c) For Parents and Caregivers: The study suggests that engagement in simple, structured cognitive games outside of school—such as "Say the Opposite" or rapid category naming games—can directly support classroom language learning by enhancing the underlying cognitive mechanisms required for language mastery.

Limitations

While the study offers valuable insights into the integration of linguistic cand cognitive training in early childhood, several limitations should be acknowledged. First, the sample size was relatively small (n = 37), which restricts the statistical power and generalizability of the findings. The participants were recruited from a single early childhood education center (Tadika Asuhan UiTM), meaning that the results may not fully reflect children from diverse cultural, linguistic, or socioeconomic backgrounds. Second, all participants were of the same age group (6 years old), which prevents a test of developmental trajectories across different stages of early childhood. Finally, the study focused on short-term outcomes, and no longitudinal data were collected to determine whether the observed benefits in English proficiency and cognitive control are sustained over time. Future research with larger, more diverse samples and extended follow-up periods would be valuable to validate and expand upon these findings.

Future Research

Future studies could extend these findings by adapting the synergistic curriculum for children with special needs. Every child learns differently and exploring how the program can be adjusted to support a wider range of learners would provide valuable insight into its inclusivity and impact. Small changes in the way activities are structured, the pace of delivery, or the level of facilitator support may make a significant difference in how these children engage and benefit from the program. Future studies might also consider implementing the curriculum across different cultural and educational contexts to assess its adaptability. In addition, longitudinal studies would be useful to observe whether the improvements in language and cognitive skills are sustained over time. These research directions will not only strengthen the evidence for the curriculum's effectiveness but also guide its development into a more inclusive and sustainable model for early education.

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