Developing pre-reading skills through movement

Pierre Romano

BMPE 7010 Dissertation Summer School Research Methods

Dr Kate Piper

September 30, 2025

Abstract

This thesis examined whether integrating physical movement into letter knowledge instruction enhanced the pre-reading skills of kindergarten students identified as being at risk of literacy challenges. In this four-week intervention, called the Active Alphabet program, phonological awareness, rapid naming, and letter identification tasks were built into gross motor activities during Physical Education classes. The study involved kindergarten students in both English and French classrooms, with data collected before and after the intervention using the district's K Protocol assessment. Analyses focused on overall gains in letter knowledge as well as differences by language of instruction and gender. Results showed that students made measurable improvements in letter identification, with comparable progress across both language groups and between boys and girls. These findings suggested that integrating movement-based activities into literacy instruction provided an engaging and effective approach to supporting early reading development and offered practical implications for reducing the number of students requiring intensive intervention in Grade 1.

Acknowledgements

I am very grateful to my supervisor, Dr Kate Piper, for her guidance, patience and constructive feedback throughout this project. Her insights helped clarify my thinking and strengthened the direction of this thesis.

This study could not have taken place without the support and consent of the Vancouver School Board. I would also like to acknowledge my principal, Michael Singh, and the kindergarten teachers, Megan Samenirad and Wendy Lau, whose mentorship, guidance, and support were invaluable. My thanks also go to all the students who participated with enthusiasm and to the volunteers whose help made the sessions run smoothly and efficiently.

I wish to extend special thanks to my Reading Recovery Teacher Leader, Winona Montgomery, who has been generous with her time, unwavering in her support, and from whom I have learned so much about early childhood literacy.

I am appreciative of my school colleagues, who showed genuine interest in my research and made time whenever I needed support. Finally, I am deeply thankful to my family for their patience, encouragement, and steady support throughout the demands of this research and writing process.

Table of Contents

Chapter 1: Introduction 7

1.1 Background and Context 7

1.2 Rationale for the research 8

1.3 Research aim 9

1.4 Research questions 9

1.5 Objectives 9

1.6 Topic justification 9

1.7 Structure of this thesis 10

Chapter 2: Literature review 11

2.1 Introduction 11

2.2 Core pre-reading skills 12

2.2.1 Phonological awareness 12

2.2.2 Rapid automatized naming (RAN) 12

2.2.3 Letter knowledge 13

2.3 Embodied learning and movement in early literacy 14

2.3.1 Embodied learning 14

2.3.2 Gibson's theory of perceptual learning 14

2.3.3 Play, movement, and learning: Why and how are they linked 14

2.4 Key studies integrating physical activity into literacy instruction. 16

2.4.1 Whole-body movement 16

2.4.2 Perceptual-motor proficiency 17

2.4.3 Structured intervention programs 17

2.4.4 Manual and handwriting skills 18

2.5 Conclusion 19

Chapter 3: Methodology 21
3.1 Ontology 21
3.2 Epistemology 21
3.3 Research design 21
3.4 Participants 22
3.5 Assessment tool - Kindergarten Screening Protocol 22
3.6 Timeline 24
3.7 Data collection 25
3.8 Data analysis 25
3.9 Ethics 25
3.9.1 Informed consent 25
3.9.2 Confidentiality and anonymity 25
3.9.3 Minimizing harm 26
3.9.4 Equity and fairness 26
3.9.5 Institutional ethics approval 26
3.10 Challenges and limitations 26

Chapter 4: Intervention 27
4.1 Background and rationale 27
4.2 The Ready Bodies, Learning Minds program 28
4.3 Connection between Ready Bodies, Learning Minds and Active Alphabet 29
4.4 Pre-intervention modifications 29
4.5 Weekly letter sequence and anchored word list 30
4.6 Program preparation 30
4.7 Volunteer involvement 31
4.8 Program schedule 31
4.9 Station descriptions 31
4.10 Branding of the program 34
4.11 Teacher collaboration 35

4.12 Bilingual adaptation 35
4.13 Fidelity of implementation 36
4.14 Summary 36

Chapter 5: Results 38
5.1 Summary of literacy measures across assessment periods 38
5.2 Changes between January and March (pre-intervention) 39
5.3 Changes between March and May (intervention period) 39
5.4 Language group comparisons 40
5.5 Gender comparisons in letter identification 41
5.6 Summary of results 43

Chapter 6: Discussion 44
6.2 Linking to theory and prior research 45
6.3 Practical implications 46
6.4 Limitations 47
6.5 Implications for practice and policy 48
6.6 Directions for future research 49
6.7 Conclusion to the discussion 50

Chapter 7: Conclusion 51
7.1 Summary of findings 51
7.2 Theoretical contributions 52
7.3 Practical and policy implications 52
7.4 Limitations and future directions 53
7.5 Final reflections 54

References 56

Appendices 60

Chapter 1: Introduction

1.1 Background and Context

Kindergarten students who have limited knowledge of letter names and sounds are at greater risk of experiencing reading difficulties and being identified as having reading disabilities (Piasta & Wagner, 2010).

My job as a Reading Recovery and French Resource teacher involves identifying and supporting students in the primary setting who are at risk in reading and writing.

Students who may be at risk in literacy are identified early in kindergarten through a combination of formal and informal assessments. The Vancouver School Board recommends that all kindergarten students complete the Kindergarten Screening Protocol (K protocol) in January, which provides a standardized snapshot of early literacy and phonological awareness skills (See Appendix 1). Classroom teachers also play a critical role by observing students' classroom engagement, behaviour, and responses to literacy instruction. These observations, alongside formal assessments, help identify students who need further individual or small group intervention. Students identified as at-risk in January are reassessed with the K protocol in May to determine whether targeted interventions have supported their progress or whether additional support will be required in grade 1.

Even with extensive support, about 20% of kindergarten students remain at risk in pre-reading skills by year's end. After further assessment in grade 1, the lowest students are invited to join the Reading Recovery program. Reading Recovery is an intensive one on one research-based program that aims to close the gap for students with literacy difficulties before they become lifelong obstacles.

Whilst the Reading Recovery program has proven effective in addressing these literacy challenges, it is a resource-intensive approach, requiring significant time and support to ensure

student success. Furthermore, despite these efforts, some students remain still at risk, even after receiving both intensive kindergarten resource support and Reading Recovery in grade 1.

1.2 Rationale for the research

This reality has led me to investigate whether integrating alternative methods, such as learning through movement, could further enhance early literacy development.

Theories such as embodied learning (Barsalou, 2008) and perceptual learning (Gibson, 2000) highlight how cognition is deeply linked to physical interaction with the world around us and that by engaging in motor and sensory experiences children are more likely to build stronger connections with their learning. In other words, movement is how children explore and make sense of their world, and learn. In my school, most teachers recognize the potential benefits of movement in enhancing learning. However, there is a lack of structured programs that put this theory into practice.

Indeed, I have not come across a program for kindergarten students that combines physical movement with letter knowledge instruction during Physical Education (PE) lessons. This research project aims to address this gap by developing a structured 4-week movement-based intervention program that is designed specifically for kindergarten students to learn their letter knowledge. The intervention program I created, is called Active Alphabet and it is designed to embed letter recognition, phonological awareness, and rapid naming tasks into gross motor activities. The aim being to make learning multi-sensory, engaging, and accessible, while also supporting motor skill development.

By adding more ways of learning letter knowledge, I am curious to see if this approach might reduce the need for additional support when these students enter grade 1. My goal is to create a concrete program that not only enriches students' letter recognition but also offers a practical and scalable approach for other teachers in the district to use.

1.3 Research aim

The aim of this research is to explore whether a PE-embedded movement program improves kindergarten letter knowledge and phonological awareness.

1.4 Research questions

- To what extent does a four-week movement-based program improve letter knowledge and phonological awareness in at-risk kindergarten students?
- Do outcomes differ by language of instruction (English/French) or by gender?
- Is the program feasible to implement within regular PE classes, considering aspects such as fidelity of delivery, staffing support, and bilingual adaptation?

Note: Initially the research questions were framed more broadly in the research proposal but were later refined following implementation constraints. The version presented here reflects the scope and feasibility of the final intervention while remaining consistent with the overarching aim of the study.

1.5 Objectives

- Design, implement, and evaluate a 4-week PE-embedded movement program and its effects on letter knowledge and phonological awareness.
- Explore differences by language and gender.
- Assess the feasibility of implementation, including materials, volunteer support, and routines, for potential school-wide use.

Note: These objectives were adapted from the original proposal and refined during implementation to better reflect the study as it was carried out, with an emphasis on feasibility and practical adaptation.

1.6 Topic justification

While Reading Recovery has demonstrated to be effective, it demands considerable time and individualized support, which may not always be feasible within the constraints of school

resources. Additionally, there is limited exploration into how incorporating movement and physical activity into literacy instruction could complement existing teaching methods and address gaps in student learning. Furthermore, few studies have explicitly examined whether combining motor skill activities with letter knowledge instruction can improve literacy outcomes for at-risk students in a school-based setting.

This research aims to address these gaps by creating a 4-week intervention program that combines gross motor skills with literacy activities during physical education classes. The goal is to assess if this movement-based approach can improve early literacy development and reduce the need for intensive support as students transition to grade 1. By designing a structured program that leverages the benefits of movement, this study seeks to offer a practical method for supporting at-risk students, that could potentially be used by other schools.

1.7 Structure of this thesis

Following this introduction, Chapter 2 presents a detailed review of relevant literature on early literacy skills, the role of letter knowledge in reading acquisition, and the theoretical perspectives of embodied learning and perceptual motor skills development. Chapter 3 outlines the research's methodology, including participant details, procedures, and data collection. Chapter 4 describes the intervention in depth, providing details of how the program was developed, how it evolved and details of each activity that was created. Chapter 5 reports the results of the research, while Chapter 6 discusses these findings in relation to the research questions and existing literature. Chapter 7 concludes the thesis, highlighting the study's implications for practice and recommendations for further research.

Chapter 2: Literature review

2.1 Introduction

The development of early literacy skills is a predictor of later academic achievement (Cooper *et al.*, 2014), and educational researchers have long emphasized the importance of specific instruction that target young learners. (Lonigan, 2006; Lonigan, Burgess and Anthony, 2000) identified three main predictors of reading success: phonological awareness (PA), rapid automatized naming (RAN), and letter knowledge. They argue that these skills form the foundation of pre-reading.

While explicit instruction in these areas is essential, there is growing recognition that the traditional classroom setting may not suit the diverse learning needs of young learners (Teschers, Neuhaus and Vogt, 2024). In particular, children who are identified as "at risk" often require approaches that are more engaging, multi-sensory, and developmentally appropriate. Movement based learning offers a new approach, rooted in theories of embodied cognition and perceptual learning. These theories suggests that physical engagement with the environment can enhance cognitive development (Barsalou, 2008; Gibson, 1969).

This chapter reviews relevant literature in three key areas:

- Core pre-reading skills, focusing on the role of phonological awareness (PA), rapid automatized naming (RAN), and letter knowledge in early literacy development.
- Embodied learning and movement in early literacy, examining theoretical frameworks that connect movement and learning.
- Key studies integrating physical activity into literacy instruction, highlighting research on movement-based approaches to teaching literacy.

2.2 Core pre-reading skills

2.2.1 Phonological awareness

Phonological awareness refers to the ability to recognize and manipulate the sound structures of spoken language, including words, syllables, onset-rime units, and individual phonemes (National Reading Panel, 2000). It enables children to work with the sounds of language independently of meaning. Early phonological awareness skills are among the strongest predictors of later reading success (Piasta and Wagner, 2010).

Phonological awareness instruction can take many forms, including activities that focus on rhyming, segmenting, blending, and manipulating sounds. Interventions targeting phonological awareness have been shown to be most effective when delivered in developmentally appropriate ways, incorporating play, repetition, and multi-sensory experiences (Pieretti *et al.*, 2015; Ehri et al., 2001). For children in kindergarten, engaging phonological awareness activities that incorporate movement such as jumping across letter markers can make abstract concepts more tangible.

2.2.2 Rapid automatized naming (RAN)

Rapid automatized naming is the ability to quickly name a sequence of familiar visual stimuli (such as letters, numbers, colors, or objects). This skill reflects the efficiency of the brain's retrieval system and the integration of visual and phonological information. Weaknesses in rapid automatized naming have been linked to reading fluency difficulties and, in some cases, dyslexia (Wolf & Bowers, 1999).

Although rapid automatized naming is often tested in seated assessment formats, the underlying processes of visual recognition, phonological retrieval, and speech production can be supported through movement-based activities. For example, physically locating and naming letters placed around the gym engages both cognitive and motor systems, potentially reinforcing speed and accuracy.

2.2.3 Letter knowledge

Letter knowledge refers to a child's understanding and recognition of letters and their corresponding sounds. This includes the ability to identify letters, by name and associate them with their phonetic sounds. It is a critical component of early literacy development, serving as a foundation for reading and writing skills. Mastery of letter knowledge is essential for children before they can read. Letter knowledge helps students to decode, and blend sounds to form words, which is crucial for their reading development.

Traditionally, letter knowledge has been taught in classrooms through visual–auditory methods, such as showing children printed letters while simultaneously modeling their sounds. More recent research, however, has examined whether multisensory approaches such as forming letters in sand or using body movements to represent letter shapes, offer an advantage over these traditional practices. Park, Piasta, and Sayer (2025) found no significant differences in outcomes between these two modes, suggesting that instructional quality and systematic exposure matter more than simply adding sensory elements.

This contrasts with studies such as Bara, Gentaz, Colé, and Sprenger-Charolles (2004), who demonstrated that sensory exploration of letters (tracing foam shapes) produced stronger gains in applying the letter knowledge to decoding than visual exploration alone. Similarly, Zemlock, Vinci-Booher, and James (2018) found that preschool children who engaged in handwriting, whether producing letters or digits, showed greater improvements in letter recognition than peers who only viewed symbols. Their findings suggest that the benefits stem not from the specific form practiced, but from the act of visually guided fine-motor production, which strengthens visual–motor integration and supports emergent literacy.

Together, these studies indicate that while there is no clear consensus on the overall effectiveness of multisensory approaches to letter recognition, carefully designed motor engagement can enhance specific components of letter knowledge.

2.3 Embodied learning and movement in early literacy

2.3.1 Embodied learning

This study is grounded in the theoretical perspectives of embodied learning and perceptual motor skills development, both of which highlight the role of physical activity in cognitive processes. Building on the work of Barsalou (2008, 2010), these theories suggest that learning is not solely a mental process but one deeply connected to the body and its movements. Learning through movement can therefore enhance cognitive development by linking action, perception, and cognition into one integrated system.

For early learners, who are still developing fine and gross motor skills, movement provides a natural pathway for acquiring new concepts. In the context of literacy, embodied learning approaches encourage linking symbolic representations (such as letters) to physical actions or sensory experiences. This multisensory integration enhances memory encoding and retrieval, making abstract concepts more concrete and accessible.

2.3.2 Gibson's theory of perceptual learning

Gibson's (1969) theory of perceptual learning explains that people learn to detect and differentiate the information available in their environment. Over time, they become better at focusing on the features that matter most for a task. In literacy, this means children learn letters and sounds best when they have many chances to see, hear, and interact with them. When combined with movement activities, perceptual learning can be even stronger, as children physically navigate spaces where letters and sounds are embedded in their environment.

2.3.3 Play, movement, and learning: Why and how are they linked

Traditional views treated cognition as amodal or separate from the body. It was common to consider the computer as a model for the human brain. The brain would act as an information processing center that received input through the senses, stored it in memory, and issued commands to the body. In this view, the brain was seen as the ruler that made every decision,

while the body functioned merely as an output device (Barsalou, 2008, 2010). This analogy shaped schooling practices that sought to train the mind while subduing the body.

Thelen, E. (2004) and Barsalou (2010) challenge the idea of amodal cognition; that the mind works like a computer processing abstract symbols without needing the body. Instead, they describe dynamic systems whereby development is not a simple cause and effect process where a sensory stimulus automatically produces a motor response.

Instead, movement emerges from the constant interaction of multiple systems, including vision, hearing, balance, the nervous system, muscles, and the surrounding social and physical environment. When children gain new locomotor abilities, such as crawling or walking, their relationship with the world changes fundamentally, providing a framework for new ways of perceiving and understanding space, objects, and people. In this view, learning arises through action: as children move, touch, see, hear, and interact, they are actively constructing knowledge about their environment. Therefore, movement is not merely a product of development but a central driver of cognition itself.

Research evidence supports these theoretical claims. For instance, Repetto, Pedroli, and Macedonia (2017) found that children learning abstract words in a second language recalled them better when gestures were used than when relying only on visual or auditory input. This shows how embodiment can strengthen symbolic learning even in areas traditionally resistant to imagery. Similarly, Iverson and Goldin-Meadow (2005) found that gesture use in young children predicted subsequent language development, suggesting that body movements can extend cognitive growth.

Together, these studies highlight that embodied experience provides a foundation for learning, linking physical activity to the acquisition of both concrete and abstract concepts. This theoretical perspective sets the stage for the following section, which reviews key studies that have directly integrated physical movement into literacy instruction.

2.4 Key studies integrating physical activity into literacy instruction.

The role of physical movement in enhancing early literacy skills has not been extensively studied but has become an area of increasing interest. Collectively, recent research demonstrates that integrating physical activity into literacy instruction can support children's acquisition of letter knowledge, though findings vary depending on the type of movement and the literacy skill assessed. This body of work can be grouped into four main strands: studies on whole-body movement, research on perceptual-motor proficiency, structured intervention programs, and investigations into manual and handwriting skills.

2.4.1 Whole-body movement

One line of research emphasizes the benefits of whole-body movement in letter learning. Bara and Bonneton-Botté (2018) showed that visuomotor activities involving large-scale body movements significantly enhanced letter recognition compared to traditional visual instruction.

Bara and Bonneton-Botté (2018) showed that visuomotor activities involving large-scale body movements significantly enhanced letter recognition compared to traditional visual instruction. In their study, kindergarten children engaged in tasks where they reproduced letter forms through whole-body actions, such as tracing letters on the ground with arm or leg movements, rather than only observing letters on a page. The results indicated that children in the movement condition not only recognized letters more accurately but also retained this knowledge more effectively over time.

Damsgaard et al. (2022) also examined the role of embodied learning in children's literacy development. In their study, children were taught letter–sound correspondences either through traditional classroom instruction or through activities that integrated whole-body movements, such as jumping, balancing, or using arm gestures to represent specific sounds. Although the researchers did not find a direct correlation between overall motor proficiency and reading

achievement, they reported significant improvements in children's ability to name letter sounds when learning was accompanied by physical movement.

Together, these studies suggest that it is not general motor ability that drives literacy gains, but rather the active engagement of the body in the learning process. Embedding whole-body actions into literacy instruction provides an additional physical pathway for learning and strengthening children's acquisition of letter knowledge.

2.4.2 Perceptual-motor proficiency

Another line of research has examined perceptual-motor proficiency, the ability to integrate sensory information with coordinated movement, and its relationship to early literacy skill. A study by Botha and Africa (2020) found a positive correlation between overall motor skill proficiency and letter knowledge, with particularly strong associations between reading outcomes and specific gross motor skills such as bilateral coordination, balance, and upper-limb coordination. Damsgaard et al. (2022), however, reported more limited evidence of such links. Their findings indicated that literacy gains emerged most clearly when movement was embedded directly in instructional activities, rather than from general motor proficiency alone.

These studies suggest that motor proficiency may provide an enabling foundation for literacy development, but its impact appears to depend on whether movement is explicitly connected to learning tasks. Rather than serving as a universal predictor of reading success, motor proficiency, seem to support children's capacity to benefit from embodied instructional approaches.

2.4.3 Structured intervention programs

A further body of research investigated structured intervention programs that deliberately integrate physical activity into literacy instruction. Unlike general motor proficiency or incidental movement, these programs are designed to systematically combine specific motor exercises with reading or letter learning tasks in order to improve both domains simultaneously.

Köse et al. (2024) evaluated a visual praxis–based occupational therapy (VPOT) program designed for children with developmental dyslexia. The intervention focused on exercises that integrated visual processing with motor actions, aiming to strengthen the coordination between sensory input and movement. Results showed that the program significantly improved both reading and motor skills, suggesting that difficulties in literacy and motor domains are closely connected and can be addressed through integrated interventions.

McClelland, Pitt, and Stein (2015) also tested a structured movement-based program, Move4Words, which combined physical exercises targeting visual attention, eye-tracking, aerobic activity, limb movement, and cross-lateral coordination. The program was particularly effective for children in the lowest academic percentiles, producing notable gains in literacy outcomes and broader academic performance.

Structured interventions which explicitly combine movement with literacy tasks can produce dual benefits for both motor and reading development. They further suggest that such programs may be especially powerful for children with identified learning difficulties or those performing below expected academic levels.

2.4.4 Manual and handwriting skills

Another area of research has focused on manual and handwriting skills, examining how fine-motor and graphomotor activities support early literacy development. These studies investigate whether the act of producing written symbols contributes uniquely to children's acquisition of letter knowledge and reading skills.

Suggate et al. (2018) distinguished between fine-motor skills (general hand coordination) and graphomotor skills (specific abilities involved in holding and using a pencil). Their study found no significant relationship between general fine-motor skills and reading ability but did

establish a a connection between graphomotor skills and early literacy outcomes. This indicates that the manual precision required for handwriting plays a more critical role in reading development than fine-motor ability in general.

Longcamp et al. (2005) extended this line of inquiry by comparing handwriting practice with typing in preschool children. They found that children who practiced handwriting demonstrated stronger gains in letter recognition than those who learned letters through typing. The study concluded that physically forming letters by hand strengthens symbol recognition, reinforcing the role of handwriting in early literacy acquisition.

Overall, these studies highlight that literacy development depends less on fine-motor skills in general and more on the targeted practice of handwriting. Actively producing letters strengthens learning in ways that visual exposure alone can't, supporting stronger connections between written symbol and their sounds.

2.5 Conclusion

Research reviewed in this chapter highlights the importance of several foundational skills for later reading achievement. Among these, phonological awareness, rapid automatized naming, and letter knowledge play a particularly central role. Letter knowledge emerges as a particularly critical skill, closely tied to children's ability to decode and blend words. While traditional visual–auditory instruction remains effective, studies on multisensory and motor-based approaches indicate that the mode of engagement can also shape learning outcomes.

The body of research integrating physical activity into literacy instruction further supports this view. Evidence from whole-body movement studies highlights the benefits of embedding gross-motor actions into letter–sound learning. In turn, research on perceptual-motor proficiency shows that motor skills help prepare children to succeed in literacy. Structured intervention programs show that deliberately combining movement with literacy tasks can

produce dual gains in motor and academic domains, particularly for children performing below expected levels. Finally, research on handwriting and graphomotor skills indicates that manual production of letters provides cognitive benefits beyond visual exposure, reinforcing symbol–sound connections.

Together, these findings point to the conclusion that physical engagement can strengthen children's acquisition of letter knowledge, whether through whole-body movement, perceptual-motor training, structured interventions, or handwriting. At the same time, the effectiveness of movement-based learning appears to vary depending on the type of motor activity involved.

Despite these promising results, notable gaps remain. Much of the existing research has examined isolated aspects of motor activity or literacy skills, rather than integrating them into a comprehensive program that targets pre-reading skills in the everyday context of school instruction. In particular, few studies have combined letter knowledge instruction with physical education, a setting where movement is already central. This research seeks to address that gap by designing and evaluating a four-week intervention that embeds phonological awareness, rapid naming, and letter knowledge tasks within movement-based activities delivered during kindergarten physical education classes.

Chapter 3: Methodology

3.1 Ontology

The ontological position of this research aligns with constructivism, where knowledge is seen as being actively constructed through interactions with the environment, rather than passively absorbed. In the context of my research, this perspective holds that young children build their understanding of letter knowledge through both cognitive engagement and physical movement.

3.2 Epistemology

The study adopts a pragmatist epistemology, where the focus is on the practical application of knowledge. Pragmatism assumes that knowledge is best understood in terms of the outcomes of actions. In this study, the goal is to determine whether learning letter knowledge through movement can lead to improved pre-reading skills. The intervention will be conducted in a real-world educational setting where the focus is on actionable insights that could help reduce the number of students requiring intensive literacy support in grade 1.

Application to the study design

This theoretical framework directly informs the design of the intervention. By combining gross motor activities with letter learning, the study builds on the idea that engaging the whole body in learning can enhance both motor skills and cognitive outcomes. The study hypothesizes that this embodied learning approach will provide students with a more complete understanding of letter knowledge, leading to better preparedness for grade 1 literacy expectations.

3.3 Research design

This research utilized an experimental design, with data collection (literacy assessments) at three points in time. The intervention, "Active Alphabet," was implemented over a four-week period during regular Physical Education (PE) classes. All instructions during the intervention

were in English, however each station was catered for the language taught in class. Both classes were in the intervention concurrently with no waiting group.

3.4 Participants

Participants were from the two kindergarten classes at my Elementary school, consisting of 38 students in total. One was a French Immersion class and one was an English program class. In January, all students in both classes were screened using the Vancouver School Board's Kindergarten Screening Protocol. Based on this screening, students were classified as either "at risk" or "not at risk" for literacy challenges. Only students identified as "at risk" participated in subsequent pre and post-intervention assessments and served as the focus group for analysis. However, all students participated in the intervention with no exclusion criteria applied.

3.5 Assessment tool - Kindergarten Screening Protocol

The Kindergarten Screening Protocol (K protocol) is a district-wide assessment tool used by the Vancouver School Board (VSB) to identify kindergarten students who may be at risk for future literacy challenges. It is administered to all kindergarten students each January, with a follow-up screening in May for those who were identified as "at risk" during the initial assessment. The purpose of the K protocol is to provide teachers with early, actionable data that can guide targeted literacy interventions during the crucial early years of schooling. The K protocol takes 20-30 minutes to administer which is a reasonable amount of time so that the process does not become too onerous for the screener nor the student.

The protocol assesses three key areas of early literacy development:

1. **Phonemic awareness:** The ability to hear and identify sound segments in words. When students have knowledge of the separate sounds in words, they can learn to hear them, identify the sound's position in words and understand the role sounds play within the

word. The K protocol helps teachers understand what individual children know specifically about segmenting and blending sounds.

Segmenting involves breaking a word into its individual phonemes or sounds. For example, hearing the word "cat" and identifying c–a–t. Blending involves combining individual phonemes or sounds to form a word. For example, hearing s-u-n and recognizing the word "sun". Phonemic awareness is widely recognized as a strong predictor of future reading success, as it serves the foundation for decoding written words.

2. **Letter identification:** An assessment to see whether the student can recognize and name the 26 lowercase and 26 uppercase letters of the alphabet. This skill is foundational to early reading, as students must be able to quickly and accurately identify letters to read. In the K protocol assessment, the student can choose to identify the letter by name, sound or by naming a word that begins with that letter. This test is beneficial to the teacher as it identifies which letters to work on and is more effective than teaching the letters alphabetically.

3. **Concepts of print:** The "Concepts of Print Assessment" has been adapted from the book," An Observation Survey of Early Literacy Achievement (2019 edition)". The author, Marie Clay, created this evaluation to check children's understanding of how print works. This includes knowledge such as reading left to right, understanding that print carries a message, identifying where to start reading on a page, and recognizing the difference between letters and words.

Through its structured, district-wide administration, the K protocol ensures that potential literacy difficulties are identified early, enabling teachers to implement timely, targeted interventions to support student success.

3.6 Timeline

After the initial K protocol assessment in both kindergarten classes, the original plan was to designate one class as the control group while the other received the intervention. Following the intervention, both classes would be retested, and then the groups would switch so each had the opportunity to participate. However, several issues arose. First, the two classes could not be compared meaningfully, as one was taught in English and the other in French. Differences in language instruction could impact how students engage with the activities and how they would acquire letter knowledge, which could complicate comparisons between the two groups Second, the K protocol is designed to reassess only students identified as at risk and not the whole group. Third, it would be ethically problematic to withhold such vital learning from one group for a month simply to serve as a control group. Therefore, the actual implementation followed a more targeted approach:

January 2025 (initial screening): All kindergarten students in the French and English classes were assessed using the Kindergarten Screening Protocol. This provided a baseline measure and identified students at risk for literacy challenges.

March 2025 (pre-intervention baseline for at-risk students): Only students identified as at-risk in January were reassessed. This step served as the formal pre-test for the study's target group. Students who were not at risk were excluded from further testing, as they had already demonstrated sufficient letter knowledge.

April to May (intervention period): The 4-week "Active Alphabet" program was delivered during regular PE classes.

May (post-intervention assessment): Students who were still deemed at-risk in March were reassessed using the Kindergarten Screening Protocol to evaluate changes in letter knowledge following the intervention.

3.7 Data collection

Data was collected at three points. As mandated by the school district, the K protocol was administered in January 2025 to all Kindergarten classes. Letter identification scores served as the primary quantitative measure of progress. Phonemic awareness and concepts of print were also monitored but were not the primary focus of the research's statistical analysis.

3.8 Data analysis

Data was analyzed using SPSS. The effectiveness of the intervention was determined by comparing pre and post-intervention scores. Statistical methods included paired t-tests to evaluate changes within each class (due to the different language) as well as testing as a whole.

3.9 Ethics

This study adhered to strict ethical guidelines to ensure the protection and well-being of all participants. The research was conducted in accordance with the Tri-Council Policy Statement (TCPS 2), which outlines ethical conduct for research involving humans in Canada.

3.9.1 Informed consent

Prior to participation, informed consent was obtained from the parents or legal guardians of all kindergarten students involved in the study. A detailed consent form outlined the purpose of the research, the nature of the intervention, potential risks, and the rights of the participants (see appendix 2). Parents were informed that participation is voluntary and that they could withdraw their child from the study at any point without any consequences or impact on their education. Additionally, verbal assent was sought from the students to ensure they understand their participation to the extent that was developmentally appropriate.

3.9.2 Confidentiality and anonymity

All data collected during the study was kept strictly confidential. Participant names and identifying information was anonymized during data entry and analysis, and any publications or

reports resulting from the research will not contain information that could identify individual participants. Data is securely stored in password protected digital files, and access is restricted to myself and my supervisor. Physical copies of data, if any, are kept in a locked storage area.

3.9.3 Minimizing harm

The research posed minimal risk to participants, as the intervention involved typical physical education activities combined with letter learning exercises that were age-appropriate for kindergarten students. However, if any discomfort or stress was observed during participation, students were allowed to opt out of specific activities. The school gym where the research took place was familiar to the students, which minimized potential anxiety or stress related to participation.

3.9.4 Equity and fairness

No student was excluded based on ability, gender, socioeconomic status, or other factors.

3.9.5 Institutional ethics approval

Prior to commencing the research, ethics approval was sought and granted from the University of Wales Trinity Saint David's ethics board. The board reviewed to ensure compliance with ethical standards and assess potential risks to participants. The research did not begin until approval was granted, and no significant changes to the research plan occurred to warrant any additional approval.

3.10 Challenges and limitations

The primary challenge was determining the extent to which any observed progress could be attributed specifically to the intervention, as opposed to regular classroom activities and instruction. An additional challenge was the inclusion of both French and English classes. This presented an additional variable for determining the effectiveness of the intervention.

Chapter 4: Intervention

4.1 Background and rationale

The initial proposal called for a 6-week intervention program combining gross motor skills with letter knowledge instruction. The program would take place twice a week during Physical Education (PE) classes. It was initially modelled on a program based on a visual praxis occupational therapy described by Köse et al. (2024). It also took ideas from an 8-week embodied learning program designed by Damsgaard et al. (2022).

In the early stage of planning, early ideas also included potential literacy-movement games such as letter hopscotch, relay races, and letter toss. While these activities were not ultimately incorporated into the program, they helped clarify the scope of the intervention and informed the final design of the six stations

As the planning progressed, the scope of creating a completely new intervention program became increasingly overwhelming. To move forward, several essential criteria were identified that the program needed to meet. First, it required a clear and structured scope and sequence for teaching letter knowledge so that learning could progress in a logical and effective way. The activities also had to promote independent learning through self-directed tasks, while remaining fun and adaptable to engage all learners. Just as importantly, the program had to be simple enough for students to participate immediately with minimal time to adapt to what was expected, and it needed to be manageable in the practical context of running two kindergarten classes simultaneously in a gym setting.

Prior to beginning the intervention, I observed what type of physical activity the kindergarten teachers taught their students. They used a program called Ready Bodies, Learning Minds (RBLM). This program consisted of seven stations that students completed three times per week during their Physical Education (PE) class. The students were highly familiar with each activity and demonstrated a clear understanding of the expectations at each station.

The RBLM framework offered several advantages for the purposes of my research. First, because students were already accustomed to the station-rotation format, there was less cognitive demand associated with learning new routines. Second, the program's emphasis on developing fundamental movement skills aligned well with my interest in integrating movement into literacy instruction. For these reasons, I chose to adapt the RBLM framework as the structural foundation for my own intervention — the "Active Alphabet" program.

4.2 The Ready Bodies, Learning Minds program

The Ready Bodies, Learning Minds program (RBLM) is based on a contemporary view of child development that links movement, perception, language, and learning, integrating dynamic systems theory, embodied cognition, and sensory-motor research (Oden, 2016). It challenges traditional views that treat physical and cognitive development as separate, instead presenting a model in which movement, perception, language, and academic learning are deeply interconnected. RBLM program is a motor-lab approach designed to develop the sensory and motor foundations necessary for academic learning. It emphasizes activities that build balance, coordination, bilateral integration, and spatial awareness. All of which are believed to support attention, focus, and learning readiness.

The program is grounded in the understanding that many children enter school without fully developed motor skills, which can impact their ability to sit still, attend to instruction, and engage in fine motor tasks such as writing. The Ready Bodies, Learning Minds activities are typically organized into stations that target specific sensory-motor domains, including:

- Vestibular and proprioceptive stimulation (balance boards, scooter boards)
- Bilateral coordination tasks (cross-body movements such as crawling)
- Eye-hand coordination (writing, throwing)
- Spatial orientation activities (obstacle courses)

Research supporting Ready Bodies, Learning Minds suggests that strengthening these foundational skills can have a positive impact on academic performance, including literacy outcomes, by improving students' readiness to learn (RBLM Program, 2016).

4.3 Connection between Ready Bodies, Learning Minds and Active Alphabet

The Active Alphabet intervention draws inspiration from Ready Bodies, Learning Minds. It uses stations, rotation schedules, and gross motor challenges but embeds explicit literacy instruction into each activity. While Ready Bodies, Learning Minds focuses on general learning readiness, Active Alphabet targets specific pre-reading skills: letter knowledge, phonological awareness and rapid automatized naming.

For example, where a traditional RBLM station might involve trampoline exercises, Active Alphabet incorporates a phoneme activity that requires the student to jump for each sound of a letter. In this way, the intervention maintains the sensory-motor benefits of Ready Bodies, Learning Minds while also addressing the literacy needs.

4.4 Pre-intervention modifications

In the weeks leading up to the intervention, one station from the Ready Bodies, Learning Minds (RBLM) program was modified at a time to incorporate literacy learning elements. This gradual introduction prevented students from becoming overwhelmed and allowed them to adjust to new tasks within a familiar structure. It also provided an opportunity to gauge students' existing movement skills. Some modifications were relatively minor, such as adding an uppercase/lowercase letter matching component to the scooter board station. Others were more substantial, including the creation of a new "Letter Tracing Writing Yoga" station.

During this trial period, a structural adjustment was also made: the number of stations was reduced from seven to six. This change was necessary due to space constraints in the gym,

which could not comfortably accommodate seven stations without overcrowding. The revised configuration enabled each station to support five or six students at a time.

4.5 Weekly letter sequence and anchored word list

In collaboration with the kindergarten teachers, the sequencing of which letters to use was established for each week (see appendix 3). Each week's activities focused on six or seven letters, selected to balance consonants and vowels and aligning with the pacing of classroom instruction. These same six or seven letters were intentionally repeated across all stations so that, as students rotated through the activities, they continually encountered the same set of letters. The stations required students to engage with the letters in different ways. For example, at one station they might form the shape of a letter with their whole body, while at another they associated the letter with an image or matched uppercase and lowercase forms. This intentional variety, combined with repeated exposure of the same letter set, was designed to reinforce recognition and retention by allowing students to experience the target letters through multiple modalities.

In addition to sequencing the letters, the kindergarten teachers and I, collaborated to create an approved list of words in both English and French that students would be familiar with (see appendix 4). For each letter, one or two anchor words were identified to serve as consistent reference points across activities. This ensured that the vocabulary introduced at the stations reinforced classroom instruction and that images selected for activities were meaningful and age-appropriate.

4.6 Program preparation

During spring break, the design of the four-week program was finalized. All materials for each station were created in advance, and a convenient method of storage and organization was developed (see appendix 7). A large master box contained six smaller boxes, one for each station. Within each station box were four sub-boxes, corresponding to the four weeks of the

program, each box containing the materials required for that week's activities. This organizational system not only minimized preparation time during the school day but also made it straightforward for others to set up the stations. In practice, grade 7 volunteers were able to prepare the setup efficiently and independently.

4.7 Volunteer involvement

Twelve Grade 7 student volunteers were recruited to assist with the setup and operation of the stations. Training these volunteers required an initial time investment; however, by the end of the intervention they were able to set up, facilitate, and pack away materials independently. Their support freed me to observe students more closely, respond to challenges as they arose, and make iterative changes to the intervention.

4.8 Program schedule

The intervention began on 31 March, 2025 and concluded on 25 April, 2025. Sessions were held three times per week for four weeks, with each session lasting approximately 30 minutes. Each session included:

- A five minute warm-up to activate gross motor skills and focus attention.
- Rotations through the six stations, with each lasting approximately 3 minutes.
- A short verbal review of the day's letters.

4.9 Station descriptions

Instructions were created for each station to guide volunteers in running their activities efficiently and effectively (see appendix 6). Below is a brief description of each station of the Active Alphabet program. Each description outlines the movement component (adapted from RBLM) and the literacy focus.

Station 1 - Hopscotch on Polyspots

- <u>Literacy focus:</u> Sound, letter name, and word association.
- <u>Setup:</u> Two lines of seven polyspots (one French, one English) with letters on each.

- Instructions: Select the weekly letters and velcro to the polyspots. Students hop on the polyspots saying the sound of that letter; the next round they say the letter names and the third round a word beginning with that letter. Volunteers assist as needed. Rotate letters across sessions.
- Objectives: Motor control, eye-foot coordination, proprioceptive input; oral practice of sounds, names, and initial-sound words.
- Materials: 14 polyspots (two lines of seven), 2 language cones (with teacher photos), 14 Velcro letters, image poster.

Station 2 - Trampoline and Teeter Board

- Literacy focus: Letter/sound identification and counting syllables.
- Setup: Trampoline beside letter wall; teeter board near an image poster.
- Instructions: A volunteer points to the letter wall and the student names it or gives the sound whilst jumping on the trampoline; on the teeter board, the student selects a picture and shifts weight on the board once per syllable count.
- Objectives: Vestibular stimulation; lower-extremity control; proprioceptive input; practice of sounds/names and syllable segmentation.
- Materials: 1 trampoline; 9 letters velcroed to the wall; 2 teeter boards; 2 image posters, 3 polyspots for queueing.

Station 3 - Scooter Board

- Literacy focus: Uppercase/lowercase letter association.
- Setup: Students lay on their bellies on scooter boards push off a wall and glide across the floor.
- Instructions: Each student gets 4 beanbags (2 uppercase, 2 lowercase). Whilst on the scooter board, they place each beanbag on its matching letter in the grid; repeat until all matched.
- Objectives: Vestibular input; core stability; proprioception; upper/lowercase matching.

- Materials: 5 scooter boards; 5 sets of 4 color-coded beanbags; 5 grids, 40 Velcro letters.

Station 4 - Sensory Crawling Tunnel

- Literacy focus: Matching initial letter to image association.
- Setup: Two sensory tunnels on mats, with letter and image cards.
- Instructions: Choose a letter, crawl through a tunnel, then place the letter beside the matching image. Dual-language compatible.
- Objectives: Full-body tactile stimulation; locomotor coordination; upper-arm/shoulder strength; letter to image association.
- Materials: 2 tunnels; 4 mats, 18 image cards, 7 letter cards.

Station 5 - Letter Writing: Hand and Body

- Literacy focus: Tracing, writing, and creating full-body letter shapes (yoga).
- Setup: Whiteboard, yoga mats, projector on the wall for student to create shadows.
- Instructions: Trace the chosen letter with finger on the whiteboard, write it with marker, form it with your body on a yoga mat with the help of a yoga pose card. The body shape is projected on the wall for visual feedback.
- Objectives: Hand strength; large-muscle control; eye-hand-body coordination; letter-shape recognition/formation.
- Materials: Whiteboard, projector, 5 markers, 5 yoga mats, 5 letter-yoga pose cards, 5 trace letters.

Station 6 - Obstacle Course

- Literacy focus: Match image to initial letter.
- Setup: Balance beams, locomotor dice and letter boxes.
- Instructions: Choose an image, cross the balance beam, roll locomotor dice and perform the action, place the image in the correct letter box.
- Objectives: Motor control; balance; locomotor skills; image to letter association.

- Materials: 2 balance beams, 2 language cones (with teacher photos), 2 locomotor dice, 16 image cards for each language, 6 lettered boxes.

Differentiation was embedded within each station so that activities could be adapted to individual student needs. For example, on the scooter board station, some students matched only a couple of beanbags to their corresponding letters, while others completed the full set of uppercase–lowercase pairs. Volunteers provided additional prompts or modeling as required. This flexibility ensured that all students, regardless of ability, could engage successfully with both the movement and literacy tasks.

4.10 Branding of the program

With a background in graphic design, I recognized that developing a clear and engaging brand identity was an important part of the intervention. Four potential names were considered—Alphabet Movers, Letter Leap, Active Alphabet, and Alphabet Acrobats. To ensure the chosen name resonated with both students and teachers, Grade 7 volunteers and kindergarten classroom teachers were polled. The results overwhelmingly favoured Active Alphabet, a name that effectively captured the spirit of the program while describing the intervention itself rather than the participants.

Once the name was established, a fun and colourful logo was created to appeal to the kindergarteners and reinforce the playful nature of the program. As part of the branding exercise, all program materials were customized with this logo, establishing a cohesive and professional visual identity. Stickers featuring the logo were also distributed to participating students at the end of the intervention to thank them of their involvement in the program.

To further strengthen the branding, a short video was produced to describe the intervention and highlight its key features. This video, along with photos of the branded materials are included in the Appendix.

4.11 Teacher collaboration

Throughout the intervention, regular debriefing took place with the kindergarten classroom teachers, who were present during the sessions. Their ongoing feedback was invaluable offering practical solutions and adjustments. These discussions not only helped refine specific activities but also strengthened the connection between the intervention and daily classroom instruction, ensuring greater consistency for the students.

4.12 Bilingual adaptation

Because the intervention was implemented across both English and French kindergarten classes, the program required careful adaptation to ensure effectiveness in both languages. While the same weekly letters were targeted across stations, the letter names and sounds often differed between English and French, requiring specific adjustments.

At Station 1 (Hopscotch on Polyspots), two parallel hopping lines were created—one for English and one for French—so that students could practice the same set of letters in their own language context. Each line was supported by a separate language specific volunteer, ensuring that students received consistent guidance in their respective language.

At Station 6 (Obstacle Course: Image to Letter Association), the challenge was greater because the same letter could not always be paired with the same image across languages. For example, in English, the letter B might be matched with a picture of a bee, whereas in French the word for bee is abeille, which begins with a different letter. To resolve this, a different image had to be used for French (e.g., bonbon for the letter B). This required building two separate sets of image cards, one for each language.

By contrast, at Station 4 (Sensory Crawling Tunnel: Letter to Image Association), images were deliberately chosen so that the same picture could be used across both languages. For instance, the letter B was represented with a picture of a boat, corresponding to boat in

English and bateau in French. The difficulty here was ensuring that all chosen words were both age-appropriate and commonly used in the classroom, so that kindergarten students would be familiar with them in both languages.

Additional adaptation for French sounds

Another layer of complexity arose with the letter C, since in French it can make two distinct sounds: k as in carotte or s as in citron. To support this, icons were added to the C cards used in Stations 4 (letter-to-image association) and station 6 (image-to-letter association). These icons acted as "sounds like" cues, helping students distinguish between the two possible pronunciations. This adaptation ensured that the literacy tasks remained clear and consistent for French learners who might otherwise confuse the sound–letter mapping.

4.13 Fidelity of implementation

To ensure consistency across sessions, the Active Alphabet program followed a structured routine and clear station guidelines. Each station included written and visual instructions, which allowed both students and grade 7 volunteers to understand expectations with minimal variation. The organizational system of pre-prepared weekly boxes further reduced opportunities for error by ensuring that all required materials were available and ready for use. I monitored every session, making observational notes and providing immediate support to volunteers as needed. This combination of standardized materials, volunteer training, and ongoing oversight supported high fidelity of implementation and helped maintain consistency in how students experienced the program.

4.14 Summary

The Active Alphabet program was adapted from the Ready Bodies, Learning Minds (RBLM) station-based format to combine movement with targeted literacy skill development. Although one activity was designed for each station during the intervention, the stations can be modified to accommodate different activities. This adaptability ensures the program can evolve to meet

different instructional needs while maintaining consistency in its structure. Organized materials, trained volunteers, and consistent practice ensured smooth operation and supported at-risk kindergarten students in developing foundational pre-reading skills

Chapter 5: Results

5.1 Summary of literacy measures across assessment periods

Students were assessed in January (baseline), March (pre-intervention), and May (post-intervention) using the district-wide kindergarten protocol. The measures included phonological awareness (segmenting and blending) and letter knowledge (uppercase and lowercase identification). Descriptive statistics indicated only limited progress between January and March, followed by more substantial growth during the March–May period, when the Active Alphabet intervention was implemented.

To evaluate these changes more formally, a series of paired-samples t-tests were conducted across the three assessment points. Analyses compared students' scores in phonological awareness and letter knowledge across two time intervals: January to March (Table 5.2) and March to May (Table 5.3). A summary of results is provided in Table 5.1.

Table 5.1 Paired-Samples t-Test Results for Literacy Measures Across Assessment Periods

Measure	Timeframe	Mean Difference	SD Difference	t(df)	p	Cohen's d
Segmenting	Jan–Mar	0.00	0.00	0.00 (4)	> .05	0.00
Blending	Jan–Mar	0.00	0.00	0.00 (5)	> .05	0.00
Lowercase Letters	Jan–Mar	−2.43	2.99	−2.15 (6)	.075	−0.81
Uppercase Letters	Jan–Mar	−1.29	1.98	−1.72 (6)	.136	−0.65
Segmenting	Mar–May	−1.60	0.55	−6.53 (4)	.003	−2.92
Blending	Mar–May	−1.83	0.98	−4.57 (5)	.006	−1.87
Lowercase Letters	Mar–May	−15.14	5.34	−7.51 (6)	< .001	−2.84
Uppercase Letters	Mar–May	−14.86	4.91	−8.00 (6)	< .001	−3.02

5.2 Changes between January and March (pre-intervention)

Between January and March, students demonstrated only modest improvements in both phonological awareness and letter knowledge. For lowercase and uppercase letter identification, mean increases were 2.43 and 1.29 letters, respectively. However, these gains were not statistically significant ($p > .05$), despite moderate-to-large effect sizes ($d = –0.81$ and $–0.65$). These findings suggest that while some progress occurred during this period, natural classroom instruction alone did not result in consistent or meaningful acceleration of early literacy skills. This interval therefore served as a baseline against which the impact of the intervention could be measured.

Table 5.2 Paired-samples t-test comparing January and March scores

Measure	Mean Jan (M)	Mean Mar (M)	Mean Diff (Mar–Jan)	SD of Differences	t(df)	p-value / d
Letter ID (lowercase)	5.57	8.00	2.43	2.99	-2.15 (6)	p = .075, d = -0.81
Letter ID (uppercase)	6.43	7.71	1.29	1.98	-1.72 (6)	p = .136, d = -0.65

5.3 Changes between March and May (intervention period)

Following the introduction of the Active Alphabet program in March, students made substantial and statistically significant improvements across all literacy measures. Segmenting and blending skills increased by an average of 1.60 and 1.83 points, respectively, with large effect sizes ($d = –2.92$ and $–1.87$). Gains in letter identification were even more pronounced: lowercase knowledge increased by over 15 letters on average, and uppercase knowledge by nearly 15, both with extremely large effect sizes ($d > –2.8$). These findings indicate that embedding literacy instruction into movement-based activities had a strong and meaningful impact on students' phonological awareness and letter knowledge, producing far greater progress than was observed during the pre-intervention period.

Table 5.3 Paired-samples t-test comparing March and May scores

Measure	Mean Mar (M)	Mean May (M)	Mean Diff (May–Mar)	SD of Differences	t(df)	p-value / d
Segmenting	0.60	2.20	1.60	0.55	-6.53 (4)	p = .003, d = -2.92
Blending	0.17	2.00	1.83	0.98	-4.57 (5)	p = .006, d = -1.87
Letter ID (lowercase)	8.00	23.14	15.14	5.34	-7.51 (6)	p < .001, d = -2.84
Letter ID (uppercase)	7.71	22.57	14.86	4.91	-8.00 (6)	p < .001, d = -3.02

5.4 Language group comparisons

Comparisons were made between the English and French cohorts across three time points (January, March, and May) on measures of phonological awareness (segmenting and blending), letter identification (lowercase and uppercase), and concepts of print.

At baseline in January, the French group outperformed the English group in phonological awareness, scoring significantly higher in both segmenting ($t(7) = -2.40$, $p = .047$) and blending ($t(7) = -7.97$, $p < .001$). No significant group differences were observed for letter identification or concepts of print ($p > .05$). By March, however, the pattern shifted: the French group continued to show stronger performance in letter identification (lowercase: $t(5) = -3.76$, $p = .013$; uppercase: $t(5) = -3.60$, $p = .016$), while differences in segmenting and blending were no longer statistically significant. Concepts of print data were not available for this assessment.

By May, no significant differences remained between the two groups across any of the measures (all $p > .05$). This suggests that although the French group initially outperformed the English group in phonological awareness and letter identification, the English group had caught up by the end of the intervention. Both groups showed strong gains during the Active Alphabet program, indicating that the intervention was effective across bilingual contexts, even

when materials required adaptation for different anchor words, sound representations, and language-specific challenges.

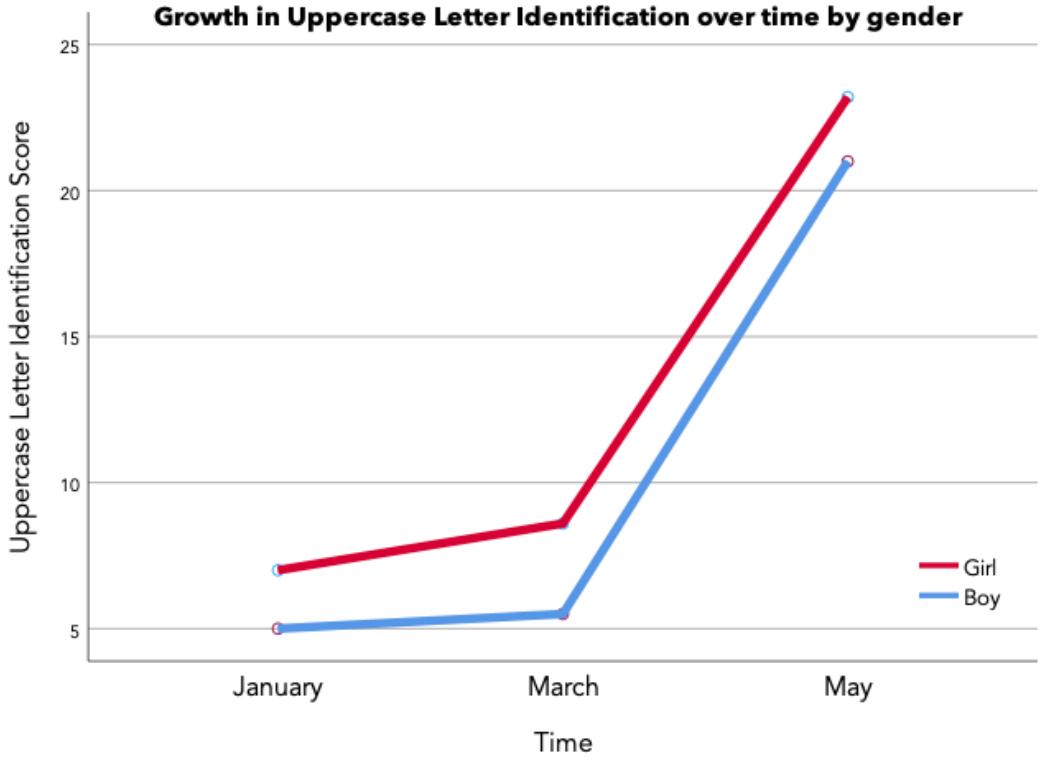
Table 5.4 Comparison of English vs. French Groups Across Three Time Points

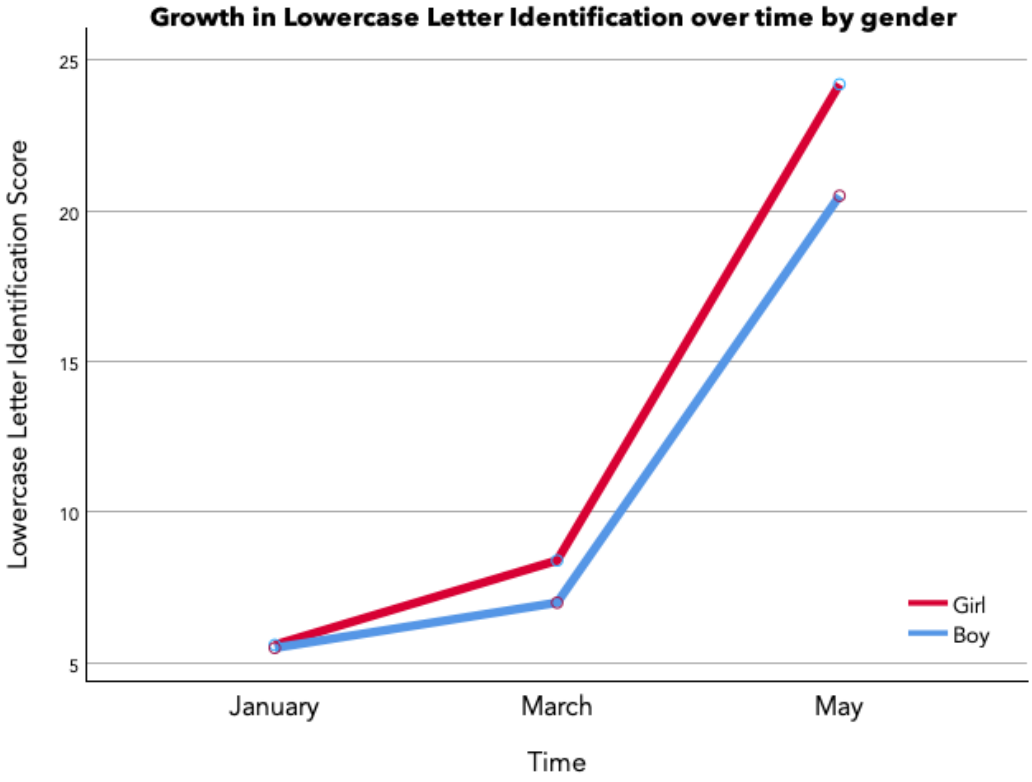
Measure	Jan Eng M	Jan Fre M	t(df)	p	Mar Eng M	Mar Fre M	t(df)	p	May Eng M	May Fre M	t(df)	p
Segmenting	0.80	2.50	-2.40 (7)	.047	0.50	1.00	-.77 (3)	.248	2.25	2.00	.234 (3)	.830
Blending	0.00	1.75	-7.97 (7)	<.001	0.00	1.00	-	-	1.80	3.00	-1.00 (4)	.374
Letter ID – Lowercase	10.40	7.75	.46 (7)	.661	2.67	12.00	-3.76 (5)	.013	22.67	23.50	-.41 (5)	.700
Letter ID – Uppercase	10.40	9.25	.20 (7)	.848	2.67	11.50	-3.60 (5)	.016	22.00	23.00	-.553 (5)	.604
Concepts of Print	3.40	6.50	-1.53 (7)	.171	-	-	-	-	-	-	-	-

5.5 Gender comparisons in letter identification

Repeated-measures ANOVAs were conducted to examine whether gains in letter identification differed between boys and girls. For uppercase identification, the main effect of gender was not significant, $F(1, 5) = 0.53$, $p = .50$, and the time × gender interaction was also not significant, $F(1, 5) = 0.05$, $p = .83$. Similarly, for lowercase identification, the main effect of gender was not significant, $F(1, 5) = 0.28$, $p = .62$, and the time × gender interaction was not significant, $F(1, 5) = 0.48$, $p = .52$.

Taken together, these findings indicate that the intervention supported boys and girls equally, with both groups demonstrating comparable improvements in uppercase and lowercase letter identification over time.


Growth in Uppercase Letter Identification over time by gender
Uppercase Letter Identification Score
25
20
15
10
5
Girl
Boy
January
March
May
Time


Growth in Lowercase Letter Identification over time by gender
Lowercase Letter Identification Score
25
20
15
10
5
Girl
Boy
January
March
May
Time

5.6 Summary of results

Students demonstrated minimal gains during the pre-intervention period (January to March) but showed substantial and significant improvements once the Active Alphabet program was introduced (March to May). These improvements were consistent across genders and evident in both English and French classes, highlighting the adaptability of the intervention. Together, these findings provide evidence that movement-based learning can play an important role in accelerating the development of phonological awareness and letter knowledge in at-risk kindergarten students.

Chapter 6: Discussion

6.1 Key findings

The purpose of this study was to investigate whether integrating physical movement into letter knowledge instruction could enhance pre-reading skills among kindergarten students identified as at risk of literacy challenges. The intervention, Active Alphabet, was designed to embed phonological awareness, rapid naming, and letter identification tasks within gross motor activities during Physical Education classes. By merging cognitive and motor learning, the program aimed to provide an engaging, multi-sensory approach that supplemented traditional literacy instruction with movement. This approach was intended to strengthen students' letter knowledge and better prepare them for the transition to Grade 1.

The results demonstrated that the intervention produced significant and meaningful gains. Between March and May, following the introduction of Active Alphabet, students made substantial improvements in both phonological awareness (segmenting and blending) and letter identification (uppercase and lowercase). The effect sizes across these measures were large, indicating a strong impact of the intervention. By contrast, the pre-intervention period between January and March showed only small, non-significant gains. These findings provide evidence that embedding literacy instruction with movement can accelerate the development of key pre-reading skills.

The data also showed no significant differences between boys and girls, suggesting that the intervention supported both genders in comparable ways. Furthermore, although the French group initially outperformed the English group in early assessments, these differences had disappeared by May, with both groups showing strong gains. This indicates that the program was effective in bilingual contexts and demonstrated its adaptability, even when materials required modification to account for different anchor words, sound representations, and language-specific challenges

6.2 Linking to theory and prior research

The findings strongly support embodied learning theory, which asserts that cognitive processes are deeply grounded in physical and sensory experiences (Barsalou, 2008, 2010). By engaging students' bodies in meaningful tasks, the Active Alphabet program allowed them to experience letters not only as abstract symbols but as actions, movements, and associations that connected sensory input with cognitive processing. The improvements observed in phonological awareness and letter knowledge align with the view that cognition is not separate from the body, but rather emerges from the dynamic interaction between motor, sensory, and cognitive systems (Thelen, 2004).

These results are also consistent with prior research. Bara and Bonneton-Botté (2018) found that visuomotor approaches in kindergarten led to stronger letter recognition compared to visual-only methods. Similarly, Damsgaard et al. (2022) reported significant benefits of whole-body learning on children's ability to name letter sounds, reinforcing the idea that physical engagement enhances literacy outcomes. Köse et al. (2024) showed that a motor-based occupational therapy intervention improved reading and motor skills in children with dyslexia, further underscoring the value of connecting movement with cognitive learning. McClelland, Pitt, and Stein (2015) demonstrated that embodied interventions targeting physical and cognitive functions were particularly effective for students in the lowest academic percentiles.

At the same time, this study adds to ongoing discussions. Research such as Suggate et al. (2018) and parts of Damsgaard et al. (2022) have shown that fine motor skills do not consistently predict reading outcomes. The present findings seem to align with the idea that gross motor embodied activities may provide stronger support for literacy learning than fine motor tasks alone. This suggests that educators could consider using whole-body engagement alongside, rather than instead of, traditional handwriting or pencil-based activities.

It is important to note that very few structured programs currently exist that systematically integrate embodied learning theory into early literacy instruction. Most prior studies, while informative, represent short-term interventions or narrowly focused activities rather than comprehensive interventions for literacy using movement. The present study contributes to filling this gap by offering a structured approach that can be embedded within Physical Education

6.3 Practical implications

The Active Alphabet intervention demonstrated several practical strengths that make it workable in schools. Embedding the program during existing PE classes, the program did not add extra demands to the kindergarten timetable showing that literacy and movement can be integrated without requiring extra instructional time.

Using Grade 7 volunteers was another strength. Their support reduced teacher workload and created opportunities for cross-grade connections, as older students acted as facilitators and role models. In addition, their involvement assisted with setup and station management, which freed up time for closer observation of student progress and for providing targeted support where needed. This was supported by a simple organizational system: each station had a main box containing sub-boxes for each week, which kept setup quick and efficient.

Working closely with classroom teachers ensured that the program was aligned with the literacy instruction already taking place in the classroom. This alignment provided consistency and reinforced student learning. The program's adaptation across both English and French classes further highlighted its flexibility, even with the challenges of working in two languages.

Another factor that made the program easy to implement was that students were already familiar with the Ready Bodies, Learning Minds framework. Since they knew the station-rotation

format and expectations, they could adapt quickly to the literacy-focused tasks, which allowed the program to run smoothly.

6.4 Limitations

Despite these promising results, several limitations must be noted. The intervention was completed over four weeks instead of the planned six weeks. Although the condensed timeframe was sufficient to produce measurable improvements, extending the program could allow for deeper consolidation of skills and provide a clearer picture of long-term retention of letter knowledge.

The sample size of at-risk students was small, limiting how broadly the findings can be applied. While the large effect sizes suggest the intervention was impactful, the results should be interpreted with caution given the small cohort. In hindsight, it would have been valuable to assess all students at the three time points (January, March, and May), regardless of risk status, as this would have produced a larger dataset and enabled comparisons across the full spectrum of learners. Future studies with larger groups would provide stronger evidence of effectiveness.

Another limitation lies in the potential for researcher and teacher bias. As the researcher, I was directly involved in both the design and delivery of the intervention. Furthermore, the kindergarten teachers, who were also my colleagues, may have been especially motivated to support its success. This raises questions about whether the same results would be observed in different contexts with less invested facilitators.

Finally, it is important to acknowledge the contextual definition of "at risk." In Vancouver, kindergarten students are expected to demonstrate certain levels of letter knowledge by mid-year. However, in other educational systems, including in the Finnish system or Montessori programs, expectations differ; kindergarten students are not required to demonstrate letter

knowledge, nor are they typically assessed for it at that stage. Therefore, the interpretation of "at risk" may vary internationally, which could influence the perceived urgency or relevance of such interventions.

6.5 Implications for practice and policy

The results of this study suggest several implications for classroom practice and educational policy. First, movement-based literacy programs such as Active Alphabet can provide an engaging and effective supplement to traditional instruction. By situating literacy within PE, schools can address the needs of at-risk learners without overburdening classroom schedules or relying on additional intensive pull-out programs.

In addition, the intervention framework could be adapted to other areas of learning. For example, numeracy concepts such as number recognition, counting, or simple arithmetic could be embedded into gross motor activities. This aligns with the broader educational goal of making early learning more multi-sensory, engaging, and developmentally appropriate.

Moreover, the program highlights the potential benefits for equity and inclusion. Multisensory, movement-based instruction may be especially valuable for English Language Learners (ELLs) as it provides alternative pathways to understanding abstract concepts. By grounding learning in physical activity, teachers can make content more accessible to students with diverse linguistic backgrounds.

While each station was implemented with a specific activity during this study, the structure of the program lends itself to ongoing development. New activities can be designed for each station using alternative movements or literacy tasks, sustaining student engagement over time and allowing the program to adapt to different instructional goals or contexts.

Finally, at the district level, the Vancouver School Board could consider piloting Active Alphabet across multiple schools. Doing so would not only provide more evidence of the program's effectiveness but could also serve as an early intervention strategy to reduce the number of students requiring costly and intensive support in Grade 1.

6.6 Directions for future research

Building on the findings of this study, future research could be developed in several areas. First, extending the intervention to six or eight weeks would allow for a more thorough investigation of the long-term benefits of movement-based literacy learning. It would be valuable to track whether gains persist into Grade 1 and whether participation reduces the number of students needing Reading Recovery or other intensive interventions.

Second, future research should involve larger and more diverse samples, ideally across multiple schools and districts. This would improve the reliability and validity of the findings while allowing for exploration of how different contexts and populations respond to the program.

Third, research should also incorporate a control group alongside the intervention group to clarify the causal relationship. One effective approach would be a crossover design, in which one class participates in the intervention while another continues with regular instruction, and then the groups switch. Ideally, the two classes would be taught in the same language (two English classes or two French classes), so that differences in outcomes cannot be attributed to language of instruction. This structure would allow comparisons to be made at the same point in time, reducing the possibility that gains are simply the result of typical classroom learning or natural developmental progress. At the same time, it would ensure equity, as all students would ultimately receive the benefits of the program.

Fourth, continued refinement of bilingual materials is recommended. Although this study demonstrated that adaptation is possible, challenges such as differing anchor words and

multiple sound representations created additional complexity. Future work could focus on designing resources that better accommodate these challenges thereby helping teachers implement it more effectively across language programs.

Finally, research could explore the transferability of the Active Alphabet framework to other subjects, such as numeracy or vocabulary acquisition. Investigating whether embodied, movement-based activities can be extended beyond literacy would provide valuable insights into the broader potential of this approach.

6.7 Conclusion to the discussion

The Active Alphabet intervention demonstrated that embedding literacy tasks within movement-based activities can significantly enhance the pre-reading skills of kindergarten students at risk of literacy challenges. The findings align with embodied learning theory and confirm the importance of connecting physical and cognitive experiences in early education. While limitations such as small sample size and short duration must be acknowledged, the program's success highlights its potential as a practical, scalable, and inclusive approach to early literacy instruction. Importantly, this study also addresses a critical gap in the field: the absence of structured programs that systematically translate embodied learning theory into literacy practice. By offering a replicable framework that integrates movement and letter knowledge instruction, the present research provides a foundation for further exploration and suggests that movement-based learning could play a meaningful role in supporting young learners' readiness for reading and long-term academic success.

Chapter 7: Conclusion

This thesis set out to examine whether integrating movement into letter knowledge instruction could enhance the pre-reading skills of kindergarten students identified as at risk of literacy challenges. The Active Alphabet intervention was designed to embed phonological awareness, rapid naming, and letter identification tasks into gross motor activities during Physical Education classes. By combining cognitive and motor learning, the program aimed to provide an engaging, multi-sensory approach that would strengthen students' early literacy skills and better prepare them for the transition into Grade 1.

7.1 Summary of findings

The results demonstrated that the intervention produced significant and meaningful improvements in pre-reading skills within a relatively short timeframe. Between March and May, after the introduction of Active Alphabet, students showed substantial gains in both phonological awareness (segmenting and blending) and letter identification (uppercase and lowercase). The effect sizes across these measures were large, suggesting that the intervention had a strong and positive impact. In contrast, the pre-intervention period between January and March showed only small, non-significant improvements.

These findings indicate that embedding literacy instruction within physical movement can accelerate the development of foundational pre-reading skills. Notably, the data revealed no significant differences between boys and girls, showing that the intervention supported both genders equally. In addition, while the French group initially outperformed the English group in early assessments, these differences had disappeared by May, with both groups showing strong gains. This suggests that the program was effective in bilingual contexts and demonstrated its adaptability, even when materials required modification to account for different anchor words, sound representations, and language-specific challenges.

7.2 Theoretical contributions

Beyond the immediate outcomes, this study makes a contribution to the broader theoretical understanding of early literacy learning. The findings strongly support embodied learning theory, which argues that cognition is grounded in physical and sensory experiences (Barsalou, 2008, 2010). By physically engaging with letters through movement, students were able to connect abstract symbols to meaningful sensory-motor experiences, thereby deepening their understanding and recall.

The results also align with dynamic systems theory (Thelen, 2004), which emphasizes that learning emerges from the interaction of multiple systems, including motor, sensory, and cognitive processes. The gains observed during the intervention period suggest that literacy development is not an isolated cognitive task but one that can be strengthened when the body and mind are engaged in tandem.

7.3 Practical and policy implications

The practical implications of this study are equally significant. By embedding literacy instruction into existing PE classes, Active Alphabet avoided placing additional strain on already crowded kindergarten schedules. This integration demonstrates that movement and literacy do not need to compete for time in the curriculum; instead, they can be combined in ways that enrich both domains of learning.

The use of Grade 7 volunteers proved to be a powerful feature of the program. Their involvement reduced teacher workload, supported classroom management, and created opportunities for cross-grade mentoring. Older students acted as facilitators and role models, and their support allowed teachers to focus more closely on observing progress and providing targeted help. This approach points to a sustainable model that schools could adopt more widely, particularly in contexts where staffing and resources are limited.

Organizational systems also contributed to feasibility. The use of pre-prepared boxes for each station and week ensured smooth transitions and reduced setup time, making the program manageable even in busy school settings. Furthermore, the program's adaptation to both English and French classes demonstrated its flexibility, while students' prior familiarity with the Ready Bodies, Learning Minds framework allowed them to adapt quickly to the new literacy-focused activities.

At the policy level, the findings suggest that movement-based literacy interventions hold promise as scalable early intervention strategies. For districts such as the Vancouver School Board, piloting Active Alphabet across multiple schools could provide a cost-effective way to address literacy gaps before students enter Grade 1. By intervening early, schools may reduce the number of students requiring intensive, resource-heavy programs such as Reading Recovery.

7.4 Limitations and future directions

This study also highlighted important limitations that shape its interpretation. The intervention was completed over four weeks instead of the planned six. Although significant gains were still achieved, a longer program may have allowed for deeper consolidation and provided clearer insight into long-term retention of skills. The small sample size of at-risk students further limits the applicability of the findings to wider populations. While large effect sizes suggest the intervention was impactful, results from such a limited cohort must be interpreted with caution.

There is also the possibility of researcher and teacher bias. As the researcher, I was directly involved in the design and delivery of the program, and the kindergarten teachers, being my colleagues, may have been especially motivated to support its success. Future studies would benefit from independent implementation to reduce this potential influence. Finally, the definition of "at risk" is context-dependent. In Vancouver, kindergarten students are expected to demonstrate certain levels of letter knowledge by mid-year, whereas in systems such as in

Finland or Montessori programs, children are not expected to demonstrate or be assessed for letter knowledge at this age.

Future research should build on these findings in several ways. Longer interventions would allow for a more comprehensive understanding of the benefits and sustainability of movement-based literacy learning. Studies with larger and more diverse samples, ideally across multiple schools and districts, would improve the reliability and transferability of results. Research designs should also incorporate simultaneous control groups, ideally using crossover models where classes can switch between intervention and control conditions. Importantly, these comparisons should be made between classes taught in the same language to reduce the potential confounding effect of language of instruction. In addition, refining bilingual materials and extending the Active Alphabet framework to other subjects, such as numeracy or vocabulary development, would further test its adaptability and broaden its relevance.

7.5 Final reflections

Overall, the results of this study provide encouraging evidence that integrating literacy instruction with movement may support the development of pre-reading skills in kindergarten students identified as at risk. The Active Alphabet program produced measurable improvements in phonological awareness and letter identification in a short period of time, while also proving feasible, adaptable, and inclusive.

In terms of theory, the findings affirm the value of embodied learning and dynamic systems perspectives in literacy development. For practice, they offer a concrete, replicable model of integrating literacy and movement within existing school structures. For policy, they highlight the potential of a scalable, preventative approach that could reduce the need for intensive literacy interventions in Grade 1.

Importantly, this study also responds to a significant gap in the field: the absence of structured programs that put embodied learning theory into a structured early literacy program. While research has consistently demonstrated the benefits of learning through movement, structured intervention programs that explicitly combine movement with learning letter knowledge remain largely absent in the literature. By offering one such model, this study contributes not only to the evidence base but also a practical toolkit available to educators to test out for themselves.

This study emphasizes that early literacy instruction can be strengthened by taking a multi-sensory, embodied approach. By connecting the body and mind in purposeful ways, educators can create richer learning experiences that engage all children, including those most at risk. Programs like Active Alphabet represent not only an innovative approach to teaching letters and sounds but also a broader vision of education that values the whole child. With further development and wider implementation, movement-based interventions have the potential to transform how young learners experience literacy, equipping them with the skills, confidence, and enthusiasm they need to thrive as readers and learners.

References

Bara, F. and Bonneton-Botté, N. (2018) 'Learning Letters With the Whole Body: Visuomotor Versus Visual Teaching in Kindergarten', *Perceptual & Motor Skills*, 125(1), pp. 190–207 Available at: https://research.ebsco.com/linkprocessor/plink?id=2edb4b27-06d6-31f4-be7f-b5a609ef6387.

Bara, F., Gentaz, E., Colé, P. and Sprenger-Charolles, L. (2004) 'The visuo-haptic and haptic exploration of letters increases the kindergarten-children's understanding of the alphabetic principle', *Cognitive Development*, 19(3), pp. 433–449 Available at: https://doi.org/10.1016/j.cogdev.2004.05.003.

Barsalou, L.W. (2010) 'Grounded Cognition: Past, Present, and Future', *Topics in cognitive science*, 2(4), pp. 716–724 Available at: https://doi.org/10.1111/j.1756-8765.2010.01115.x.

Botha Sharnay and Africa, E.K. (2020) 'The Effect of a Perceptual-Motor Intervention on the Relationship Between Motor Proficiency and Letter Knowledge', *Early Childhood Education Journal*, 48(6) Available at: https://doi.org/10.1007/s10643-020-01034-8.

Cooper, B.R., Moore, J.E., Powers, C.J., Cleveland, M. and Greenberg, M.T. (2014) 'Patterns of Early Reading and Social Skills Associated With Academic Success in Elementary School', *Early Education and Development*, 25(8), pp. 1248–1264 Available at: https://doi.org/10.1080/10409289.2014.932236.

Damsgaard, L., Nielsen, A.V., Gejl, A.K.æ, Malling, A.S.B.ø, Jensen, S.K. and Wienecke, J. (2022) 'Effects of 8 Weeks with Embodied Learning on 5–6-Year-Old Danish Children's Pre-reading Skills and Word Reading Skills: the PLAYMORE Project, DK', *Educational psychology review*, 34(3), pp. 1709–1737 Available at: https://doi.org/10.1007/s10648-022-09671-8.

Ehri, L.C., Nunes, S.R., Willows, D.M., Schuster, B.V., Yaghoub-Zadeh, Z. and Shanahan, T. (2001) 'Phonemic Awareness Instruction Helps Children Learn to Read: Evidence from

the National Reading Panel's Meta-Analysis', *Reading Research Quarterly*, 36(3), pp. 250–287 Available at: http://www.jstor.org.ezproxy.uwtsd.ac.uk/stable/748111.

Gibson, E.J. (1969) *Principles of perceptual learning and development* New York: Appleton-Century- Crofts.

Gibson, E.J. (2000) 'Perceptual Learning in Development: Some Basic Concepts', *Ecological Psychology*, 12(4), pp. 295–302 Available at: https://doi.org/10.1207/S15326969ECO1204_04.

Iverson, J.M. and Goldin-Meadow, S. (2005) 'Gesture Paves the Way for Language Development', *Psychological science*, 16(5), pp. 367–371 Available at: https://doi.org/10.1111/j.0956-7976.2005.01542.x.

Köse, B., Temizkan, E., Şahin, S., Kara, K. and Uyanık, M. (2024) 'Effects of a visual perception-based occupational therapy program on reading and motor skills in children with developmental dyslexia: Single blind randomized cross-over study design', *Dyslexia*, 30(3), pp. e1773–n/a Available at: https://doi.org/10.1002/dys.1773.

Longcamp, M., Zerbato-Poudou, M. and Velay, J. (2005) 'The influence of writing practice on letter recognition in preschool children: A comparison between handwriting and typing', *Acta Psychologica*, 119(1), pp. 67–79 Available at: https://doi.org/10.1016/j.actpsy.2004.10.019.

Lonigan, C.J., Burgess, S.R. and Anthony, J.L. (2000) 'Development of emergent literacy and early reading skills in preschool children: Evidence from a latent-variable longitudinal study', *Developmental psychology*, 36(5), pp. 596–613 Available at: https://doi.org/10.1037/0012-1649.36.5.596.

McClelland, E., Pitt, A. and Stein, J. (2015a) 'Enhanced academic performance using a novel classroom physical activity intervention to increase awareness, attention and self-control: Putting embodied cognition into practice', *Improving schools*, 18(1), pp. 83–100 Available at: https://doi.org/10.1177/1365480214562125.

McClelland, E., Pitt, A. and Stein, J. (2015b) 'Enhanced academic performance using a novel classroom physical activity intervention to increase awareness, attention and self-control: Putting embodied cognition into practice', *Improving Schools,* 18(1), pp. 83–100 Available at: https://doi.org/10.1177/1365480214562125.

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.* Washington, DC: National Institute of Child Health and Human Development. Available at: https://www.nichd.nih.gov/sites/default/files/publications/pubs/nrp/Documents/report.pdf

Oden, A. (2016) *Ready Bodies, learning minds: Cultivating the complete child* Texas:.

Park, S., Piasta, S.B. and Sayer, P.M. (2025) 'An initial yet rigorous test of multisensory alphabet instruction for english monolingual and emergent bilingual children', *Early Childhood Research Quarterly*, 72, pp. 328–338 Available at: https://doi.org/10.1016/j.ecresq.2025.04.008.

Piasta, S.B. and Wagner, R.K. (2010) 'Developing Early Literacy Skills: A Meta-Analysis of Alphabet Learning and Instruction', *Reading Research Quarterly*, 45(1), pp. 8–38 Available at: https://doi.org/10.1598/RRQ.45.1.2.

Pieretti, R.A., Kaul, S.D., Zarchy, R.M. and O'Hanlon, L.M. (2015) 'Using a Multimodal Approach to Facilitate Articulation, Phonemic Awareness, and Literacy in Young Children', *Communication disorders quarterly*, 36(3), pp. 131–141 Available at: https://doi.org/10.1177/1525740114545360.

Repetto, C., Pedroli, E. and Macedonia, M. (2017) 'Enrichment Effects of Gestures and Pictures on Abstract Words in a Second Language', *Frontiers in Psychology*, olume 8 - 2017 Available at: https://www.frontiersin.org/journals/psychology/articles/10.3389/fpsyg.2017.02136.

Suggate, S., Pufke, E. and Stoeger, H. (2018) 'Do fine motor skills contribute to early reading development?', *Journal of Research in Reading*, 41(1), pp. 1–19 Available at: https://doi.org/10.1111/1467-9817.12081.

Teschers, C., Neuhaus, T. and Vogt, M. (2024) 'Troubling the boundaries of traditional schooling for a rapidly changing future – Looking back and looking forward', *Educational Philosophy and Theory*, 56(9), pp. 873–884 Available at: https://doi.org/10.1080/00131857.2024.2321932.

Thelen, E. (2005) 'Dynamic Systems Theory and the Complexity of Change', *Psychoanalytic Dialogues*, 15(2), pp. 255–283 Available at: https://doi.org/10.1080/10481881509348831.

Thelen, E. (1995) 'Motor development: A new synthesis', *American Psychologist*, 50(2), pp. 79–95 Available at: https://doi.org/10.1037/0003-066X.50.2.79.

Wolf, M. and Bowers, P.G. (1999) 'The double-deficit hypothesis for the developmental dyslexias', *Journal of educational psychology*, 91(3), pp. 415–438 Available at: https://doi.org/10.1037/0022-0663.91.3.415.

Appendix 1

Kindergarten Screening Protocol K protocol

Phonological Awareness

Administration

- Prepare one "Assessment Summary" sheet for each student.

Segmenting Sounds

- During the assessment you may have student look at the pictures provided. These pictures are to support ELL students and visual learners, but if you find they are unnecessary or confusing for the child do not use them.
- Model the practice items with the child.
- Use clapping or other strategies you have used in class activities to support the child.
- If you are unsure that the child understands what is being asked you may do other practice examples before beginning the test items.
- Once you have begun the test items do not offer additional hints.
- The child must answer 3/4 in Level 1 and 2/3 in Level 2-4 of the items correctly to advance to the next level.
- Record level of achievement; last successful level. If the child cannot complete "Level One" record "No evidence."

Level 0 - 1 = concern Level 2 – 4 = no concern

Blending Sounds

- Model the practice items with the child.
- Use visual hand strategies you have used in class activities to support the child.
- If you are unsure that the child understands what is being asked you may do other practice examples before beginning the test items.
- Once you have begun the test items do not offer additional hints.
- The child must answer 2/3 of the items correctly to advance to the next level.
- Record level of achievement. If the child cannot complete "Level One" record "No evidence."

Level 0 = concern Level 1 – 3 = no concern

Phonological Awareness Assessment Summary

Name: _____ Date: _____

Skill 1: Segments Sounds

	Level 1	Level 2	Level 3	Level 4
Practice Items	turtle umbrella	monkey snake	bat car bug	rat duck boat
Test Items	tiger elephant puppet tree	man fish lion	d-og s-it b-ed	p-i-g g-a-me c-a-t

Skill 3: Blends Sounds

	Level 1	Level 2	Level 3
Practice Items	Zebra Umbrella	ch-air f-an	j-o-g c-a-ke
Test Items	candy crayon pencil	f-ire m-ilk p-en	s-u-n l-ea-f b-oa-t

Phonological Awareness Tasks

The three phonological awareness skills to be evaluated (segmenting sounds, rhyming and blending sounds) are leveled by complexity. The teacher models or demonstrates the required task before asking the child to perform it.

The child must independently complete **two of three items** at each level to move to the next level of that skill. Mark a level as **"No Evidence"** if child cannot successfully complete level one. **When assessing, stop when a child makes two consecutive errors at a level.** Do not go to next level. (Articulation errors should not count against the child.)

Prompt: ***"Let's play a game with words. Some of the games might be easy. Some games might be harder. Just do your best."***

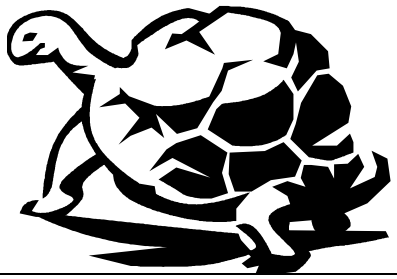
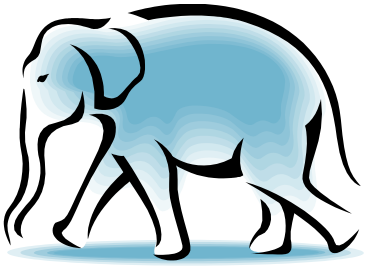
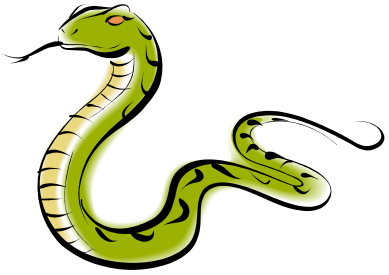
1. **SKILL – Segments Sounds**			
LEVEL ONE	***LEVEL TWO***	***LEVEL THREE***	***LEVEL FOUR***
Segments Syllables *Model:* *We're going to clap and say some words.* *Let's clap and say "turtle."* (Clap each syllable as you say it, *tur-tle).* Repeat with "umbrella."	**Segments the First Sound** Model: *Let's listen to the first sound in these words: "mmmonkey."* (Stretch first sound a bit.) *The first sound is "mmm," monkey. Did you hear it?* Encourage child to join in. *Let's do one more: "sssnake." – "What's the first sound?"*	**Segments One-Syllable Words into Onset and Rime** Model: *This time we're going to say the first sound and then the rest of the word.* *Let's try bat: "b - at."* *Let's try car: "c - ar."* *Let's try bug: "b - ug."*	**Segments One-Syllable Words into Phonemes** Model: *This time we're going to say all the sounds in the word.* *Let's try rat:* "r - a - t." *Now let's do duck*: "d - u - ck." *How about boat:* "b - oa - t."
Prompt: 1. *Now you try.* Teacher says "tiger" as one word. Child is correct if he can either separate the syllables orally or clap the appropriate number of times, or both. 2. *"elephant"* 3. *"puppet"* 4. *"tree"* Other examples may be used to keep game "fresh." If three of four items are done correctly, move to the next level.	Prompt: 1. *Now you try on your own: "mmman" –* *"What's the first sound?"* 2. *"fffish"* *"What's the first sound?"* 3. *"llllion"* *"What's the first sound?"*	Prompt: 1. *Now you try on your own: "dog."* (Correct response is "d - og.") 2. "sit" 3. *"bed"*	Prompt: 1. *Now you try on your own: "pig."* (Correct response is "p - i - g.") 2. *"game"* 3. *"cat"*

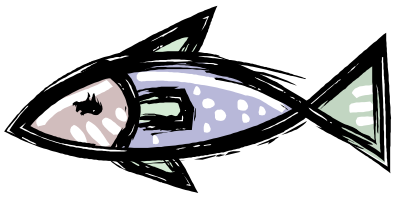
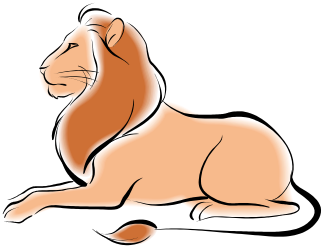
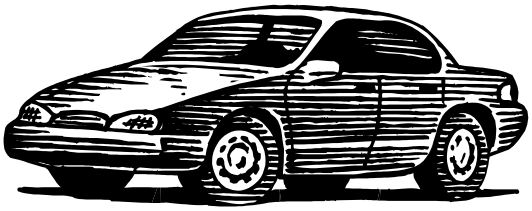
Developed by Pam Richmond for School District 73. Used with permission.

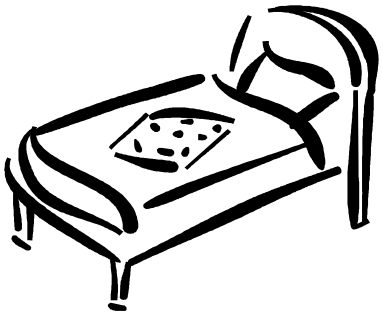
3. SKILL – Blends Sounds		
LEVEL ONE	**LEVEL TWO**	**LEVEL THREE**
Blends Syllables Model: *Let's put some parts together to make words. Listen and try this one with me: "ze - bra." That makes "zebra."* *Here's another one: "um-brel-la." That makes "umbrella."*	**Blends Onsets and Rimes** Model: *Now let's try these ones: "ch - air." That makes "chair." "f - an." That makes "fan."*	**Blends Phonemes** Model: *This time we're going to put together three sounds to make a word. Listen and try this one with me: "j - o - g." That makes "jog." "C - a - ke." That makes "cake."*
Prompt: 1. *Now you try: "can - dy" -- What word does that make?* 2. *"cray - on"* 3. *"pen-cil"*	Prompt: 1. *Now you try: "f - ire" -- What word does that make?* 2. *"m - ilk"* 3. *"p - en"*	Prompt: 1. *Now you try: "l -e a – f ": -- What word does that make?* 2. *"s - u - n"* 3. *"b - oa - t"*

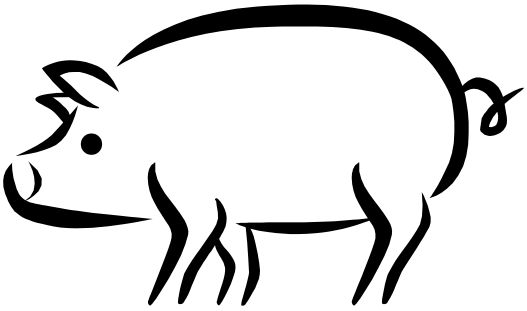
Alternate List of Two and Three-Syllable Words for Segmenting and Blending if needed

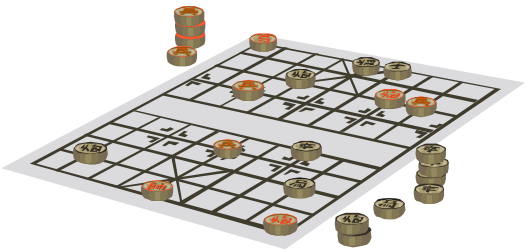
Two-Syllable words:		
apple wagon table	hockey summer popcorn	winter rabbit cookie
Three-syllable words:		
September Saturday bicycle	elephant dinosaur trampoline	banana October Cucumber

Stimulus Pictures for Segmenting Tasks	
	
	
	







Concepts of Print Assessment

Adapted from the Observation Survey of Early Achievement, 2019

Administration

- Most of these concepts relate to orientation and directionality which are important to establish early in reading instruction.

- Use any emergent reading book for this task. The book must have an obvious front and back cover and a first page with both a picture and **two lines of text on it**. It would be best if the text was written in a large font. Any level 2-3 from PM Starters, LLI Orange Kit, Literacy Place or an equivalent reading series would be easiest to use.

- Start by handing the student the book with the spine pointing at the student and asking the first question, "**Show me the front of the book**."
- **Note:** Avoid giving non-verbal cues when asking questions (e.g., looking at the front of the book or pointing when you ask, "Show me the front of the book.").

- Next, tell the child, "**I'll read this story. You help me. Show me where to start reading… Where do I begin to read?**" (Student should point to the left corner of the first line of text.)

- Then ask, "**Which way do I go**?" (Student should indicate a left-to-right direction along line of text). And "**Where do I go after that?**"(Student should point to second line of text)

- If the student doesn't start in the right place or sweep left-to-right, say "Let's start here (indicate first word) and go this way (sweep to right).

- "**Point to it while I read it**." Read the first line slowly but smoothly. (Student should be able to point to each word as you say it.)

- Now ask, "**Show me the bottom of the picture**." (student points to bottom of page)

- Say, "**Show me the first part of the story**" (1st line of page or 1st page of book accepted)
- Then, "**Show me the last part of the story**" (bottom line, last word of page or last page of book accepted).

Recording and Scoring

- Mark a '+' for each task the student completes correctly and promptly and a '--' for each one they miss or struggle with significantly. There is a total of 8 possible points in the task and a child is considered at risk if they score less than 4 (0-3).

Concepts of Print Assessment Score Sheet

These items were demonstrated as appropriate for kindergarten age children in the random sample standardization of the *Observation Survey of Early Achievement*, 2019.

Student	**Date**
Teacher Directives	**+ or -**
(Hand book to student, spine forward) "**Show me the front of the book**."	
"**I'll read this story. You help me. Show me where to start reading… Where do I begin to read?**"	
"**Which way do I go?**"	
(When they get to end of line) "**Where do I go after that?**"	
"**Point to it while I read it.**"	
"**Show me the bottom of the picture**."	
"**Show me the first part of the story**"	
"**Show me the last part of the story**."	
Total +'s	/8

0-3 = concern 4 – 8 = no

Concepts of Print Assessment Score Sheet

These items were demonstrated as appropriate for kindergarten age children in the random sample standardization of the *Observation Survey of Early Achievement*, 2019.

Student	**Date**
Teacher Directives	**+ or -**
(Hand book to student, spine forward) "**Show me the front of the book**."	
"**I'll read this story. You help me. Show me where to start reading… Where do I begin to read?**"	
"**Which way do I go?**"	
(When they get to end of line) "**Where do I go after that?**"	
"**Point to it while I read it.**"	
"**Show me the bottom of the picture**."	
"**Show me the first part of the story**"	
"**Show me the last part of the story**."	
Total +'s	/8

0-3 = concern 4 – 8 = no

Letter Identification Assessment

Adapted from: *An Observation Survey of Early Literacy Achievement* (2019)

Administration

Use the following template to assess student recognition of names or sounds of lowercase and uppercase letters. Make sure the student reads the letters across the page, rather than in columns so alphabetical order does not affect results. Accept the letter name, sound or a word beginning with the letter as a response. DO NOT ASK FOR NAME, SOUND AND WORD FOR THIS ASSESSMENT. More in depth assessment can be done separately.

If necessary, cue the student with any of the following prompts:

- What do you call these?
- Can you find any of these that you know?
- (Pointing to a letter) Do you know this one?
- Do you know its name?
- What sound does it make?
- Do you know a word that starts like that?

Repeat this prompting with other letters if needed.

Recording and Scoring

- On the student record, check under 'A' if the student gives the correct name of the letter. Check under 'S' if the students give a correct sound for the letter. Check under 'W' if the student gives a word that starts with the appropriate sound (doesn't have to be the appropriate letter – e.g., "giant" for 'j' is acceptable). It is helpful to record the word.

- Record the child's actual attempt under IR if they make an error. This is useful information for analyzing how a student is relating to the alphabet (e.g., what mode the student prefers to use to ID letters, whether there are patterns in the child's errors, etc.)

- A student gets a point for any letter that they can correctly name, produce a sound for **or** say a word starting with that sound. There is a possible total of 52 points for the full assessment – one for each lowercase and each uppercase letter.

- A child who scores less than 35 should be considered at risk.

Letter Identification Assessment Score Sheet

Date _____ Name _____

Assessor _____ Division _____

UC Letters	A	S	Word	IR	LC Letters	A	S	Word	IR
A					a				
F					f				
K					k				
P					p				
W					w				
Z					z				
B					b				
H					h				
O					o				
J					j				
U					u				
C					c				
Y					y				
L					l				
Q					q				
M					m				
D					d				
N					n				
S					s				
X					x				
I					i				
E					e				
G					g				
R					r				
V					v				
T					t				
Totals					**Totals**				

Observations:

KEY:

A - **A**lphabet response: tick (check)
S - Letter **S**ound: tick (check)
Word - Record the **word** the child gives
IR - **I**ncorrect **R**esponse: record what child says

Letter Identification

A	F	K	P	W	Z
B	H	O	J	U	
C	Y	L	Q	M	
D	N	S	X	I	
E	G	R	V	T	
a	f	k	p	w	z
b	h	o	j	u	
c	y	l	q	m	
d	n	s	x	i	
e	g	r	v	t	

Appendix 2

Informed consent form

QUILCHENA ELEMENTARY SCHOOL

5300 Maple Street
Vancouver, B.C. V6M 3T6
Telephone: 604.713.5420 Fax: 604.7135422

Informed Consent for Parents – March 4th, 2025

Dear Parent/Guardian

As part of my Masters in Physical Education Sport and Physical Literacy at University of Wales Trinity Saint David, I have undertaken to research whether learning through movement improves pre-reading letter knowledge in kindergarten students.

The research will take place three times a week during Ready Bodies, Learning Minds. I have created a 3 week program based on activities that are designed to integrate physical movement with learning letter knowledge in a fun and engaging way. All students in the class will be assessed for letter knowledge before and after the program using the K protocol, a district standard assessment tool. I would like your permission to use the data from the district approved assessment tool (K-protocol) to use as part of my research.

I understand that participation in this project is **voluntary** and **anonymous**. If your child or you wish not to have their data included at any point during the research, you or they can request to not have the work included. Students will be under no pressure and at no risk of negative effect should they choose not to participate in the research. In addition, there will be no negative impact on their gym experience, teacher feedback or grades. All aspects of the research are part of a regular curriculum, so that all students regardless of participation in the research will experience the entire program. The only difference being that only those participants that have consented will have their data included in the research. My research will run between March 31st, 2025 to April 17th, 2025

Your child's safety is of the utmost importance to me. I will protect your child's privacy by removing their name and any other information that would identify them. The teaching and assessment involved in this study are part of our regular teaching practice and requirements relating to the Provincial curriculum. The materials I am working on will not be sold for profit and will only be used for academic purposes, such as being assessed by my instructor.

I would be happy to discuss any element of my research with you. Furthermore, this research will have no impact on your child's progress or grade in the courses I teach. If you are comfortable with my request at this time, please complete the form below.
Thank you for your help.

Pierre Romano
promano@vsb.bc.ca

As the parent/guardian of _____,

□ I do not give permission

□ I give permission to Mr Pierre Romano to use the K protocol data of my child for his research during the 2024-25 school year. I understand that my child's privacy will be protected, and the material will not be sold for profit.

Appendix 3

Weekly letter focus

ACTIVE ALPHABET

Letter Focus

Week 1

Ll Ii Tt Ff Cc Oo Pp

Week 2

Ee Aa Dd Ss Uu Rr Gg

Week 3

Nn Mm Hh Bb Jj Qq

Week 4

Vv Ww Yy Xx Zz Kk

Appendix 4

Anchored word list in French and English

Anchored word list: English

A
apple
ant
airplane
alligator

B
ball
banana
butterfly
bat
bee
bouncing ball

C
cat
car
cake
cow
cold
cough

D
dog
duck
drum
down dragon

E
elephant
egg
engine

F
fish
frog
flower
funny fish

G
goat
grapes
guitar
grass
giggling girl

H
hat
horse
helicopter
huff puff

I
ice cream
igloo
insect
incky ink

J
jump
jelly
jacket
jump jiggle

K
kite
kangaroo
key
kicking kangaroo

L
lion
leaf
lamp
lollipop

M
monkey
moon
milk
mouse
marchmallow

N
nest
nose
nut
net
no never

O
octopus
orange
owl

P
pig
pizza
pencil

Q
queen
quilt
quail
quiet queen

R
rabbit
rainbow
robot
run the motor

S
sun
snake
star
snow
hissing snake

T
tiger
tree
train
tennis
turtle

U
umbrella
unicorn
up

V
violin
volcano
van

W
whale
watermelon
window
worm
wild wind

X
xylophone
x-ray
box

Y
yak
yellow
yo-yo
yummy yam

Z
zebra
zipper
zoo
zip the zebra

Anchored word list: French

A
avion
ami
acrobat
arbre

B
bateau
banane
ballon
bébé
bâton
bonbon
bleu

C
citrouille
cercle
carré
carotte

CK
carotte

CH
chat
chocolat
chien

D
dauphin
descendre
danse
dent
dinosaure

E
je

É
école
étoile
éléphant

F
fleur
froid
famille
fraise

G
gâteau
guitare
grenouille
garçon
glouglou
gris
girafe
genou

H
hibou
hiver
haleine

I
souris
igloo

J
jongleur
jouet
jus
jaune

K
karaté
koala

L
livre
lune
lit
langue
lion
lapin

M
maison
maman
musique
moto

N
neige
nex
non
nez

O
océan
ovale
oreille

P
papillon
pluie
pomme
papa
pied
poisson

QU
quatre
question
Quilchena

R
rugir
robe
rouge
roi
rose

S
soleil
serpent
sac
soulier

T
table
tennis
tapis
tête
tigre
tortue

U
lune
uniforme

V
voiture
vélo
vert

W
week-end
wagon

X
xylophone
klaxon

Y
yaourt
yoyo
yoga
yeux

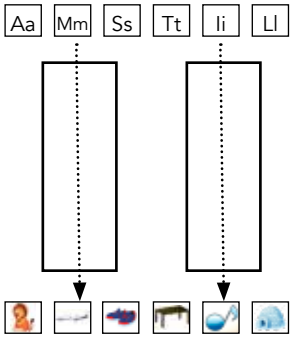
Z
zèbre
zoo
zéro
zigzag

Appendix 5

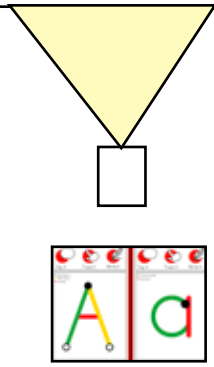
Floorplan of Active Alphabet intervention

Floorplan

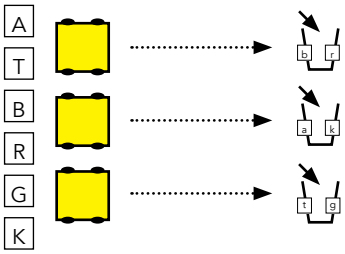
Station 4
Tunnel
letter to image
association



Station 5
Letter tracing
with hand then on
white board and
then yoga shapes
with projector

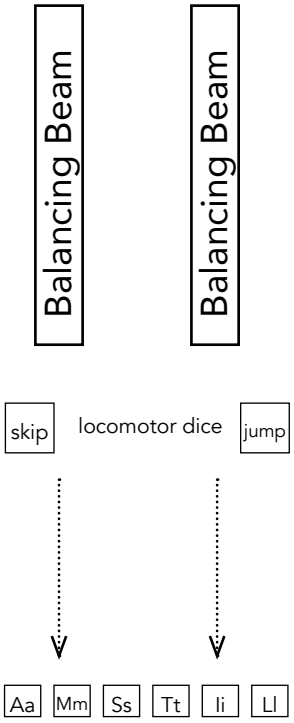


Station 3
Scooter board :
Upper to lowercase
association



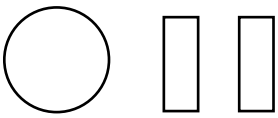
Warmup area

Station 6
Obstacale course
image to letter
association
Dual track FR/ENG

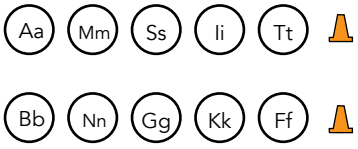


Station 2
Trampoline: Letter/
sound identification

Teeter board: counting
syllables of student



Station 1
Hopscotch with
polyspots. Sound,
Lettername and
word association.
Dual track FR/ENG



Stage

Appendix 6

Instructions for each station

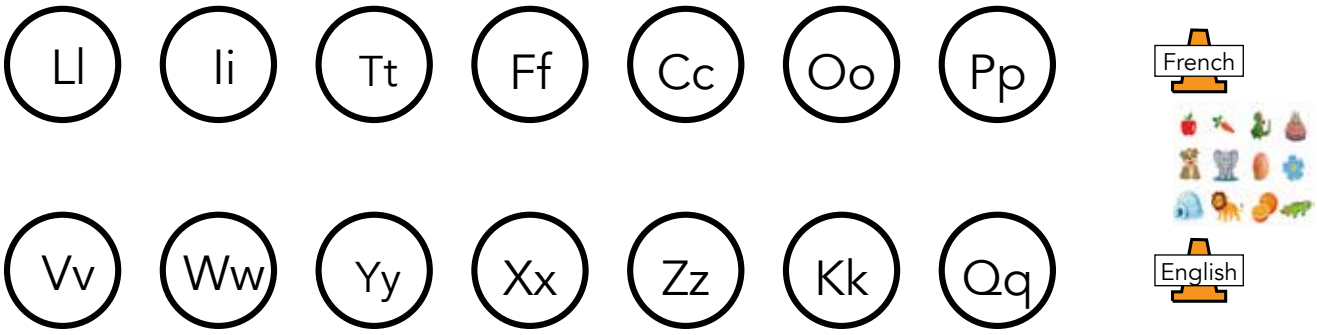
ACTIVE ALPHABET

Station 1
Hopscotch on polyspots
sound, letter name and word association

Objectives:
- Develops motor control and skills
- Develops eye-foot coordination
- Increases proprioceptive input through jumping
- Oral Practice of letter sounds, names and words associated to a letter

Materials
- 7 Polyspots per line
- 2 cones identifying the French and English line up by using a photo of the classroom teacher
- 14 velcroed letters
- 1 image poster to help think of words with the associated letters

Activity Type:
- Motor Control, Locomotor



Instructions:
- Make 2 lines of 7 polyspots (one for French and one for the English class)
- Use all green polyspots for one line and multicoloured polyspots for the other
- Select the letters for the week and attach them to the polyspots using velcro. Letters with a green dot will be placed on the green polyspots
- Students will line up behind the cone that corresponds to their language group
- One at a time, students will hop along the polyspots, saying the sound of each letter as they land on it. The students waiting in line can look at the image poster to help them think of words for each letter.
- Volunteers will assist any students who need help.
- Students will repeat the hopscotch two more times. First, saying the letter names and then, saying a word that begins with each letter.
- Rotate letters for each session during that week

ACTIVE ALPHABET

Station 2

Trampoline and Teeter board

letter/sound identification and counting syllables

Objectives:

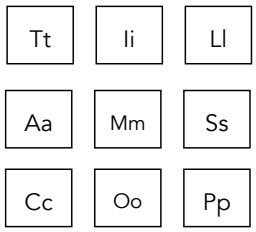
- Stimulates linear vestibular responses
- Develops control of lower extremities
- Increases proprioceptive input through bouncing
- Oral Practice of letter sounds, names and breaking words into syllables

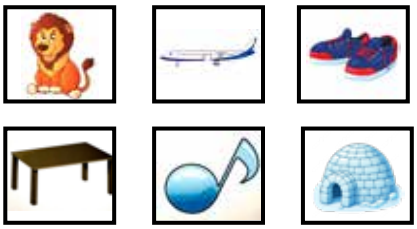
Materials

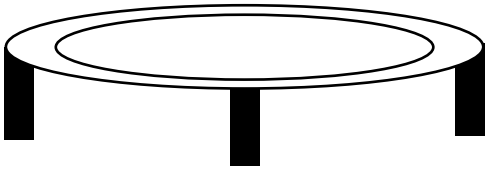
- 1 trampoline
- 9 letters velcroed on wall
- 2 teeter boards
- 2 image posters velcroed on wall
- 3 polyspots demarcating where students should wait in line

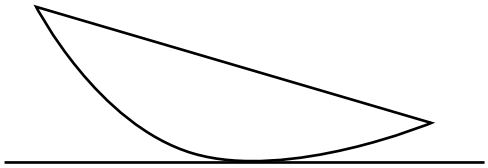
Activity Type:

- Motor Control, Proprioceptive









Instructions:

- Place the trampoline next to a wall and attach the letters of the week to the wall using Velcro.
- Set up the teeter board near a wall, and Velcro the poster with images to the wall.
- Students will alternate between the trampoline and the teeter board activities.
- Trampoline Activity: A volunteer points to a letter on the wall. The student identifies the letter by naming it or producing its sound.
- Teeter Board Activity: The student selects an image from the poster. They count the syllables in the word by shifting their weight from side to side on the teeter board—one shift per syllable.

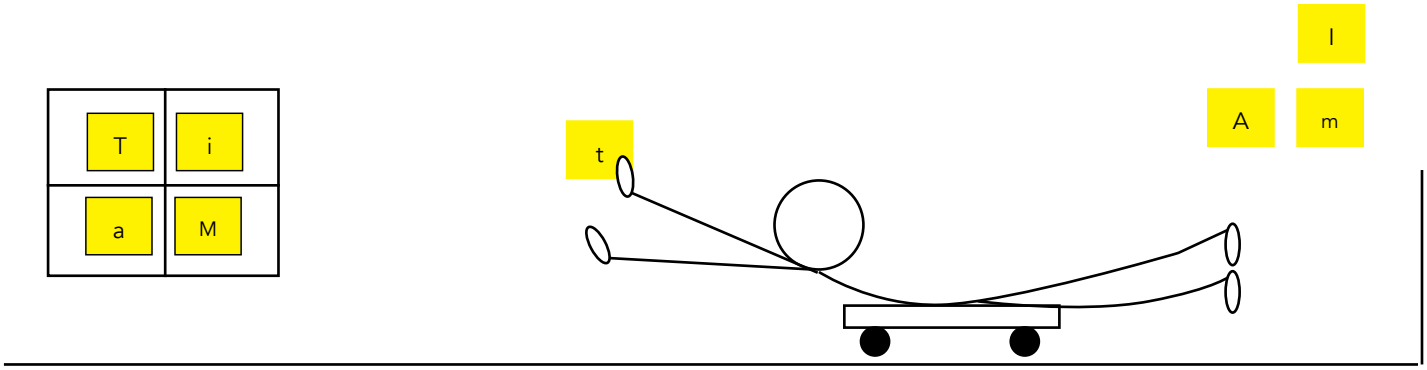
ACTIVE ALPHABET

Station 3
Scooter Board
uppercase and lowercase letter association

Objectives:
- Stimulates linear vestibular responses
- Develop control of core stability
- Increases proprioceptive input through pushing with legs and arms
- Upper and lowercase letter matching

Materials
- 5 scooter boards
- 5 sets of 4 beanbags (each colour coded)
- 5 grids
- 40 velcroed letters that need to be match for each scooter board

Activity Type:
- Vestibular, Motor Control, Proprioceptive



Instructions:
- The objective is for students to match uppercase or lowercase letters (on bean bags) to the corresponding letters on a grid.
- Give each student 4 bean bags – 2 uppercase letters and 2 lowercase letters.
- Have the student lie on their stomach on the scooter board, legs extended and feet off the ground. Position their feet against the wall. The student pushes off the wall to ride the scooter across the floor.
- While riding, the student carries a bean bag and places it on the matching letter on the grid.
- Repeat until all bean bags are matched.

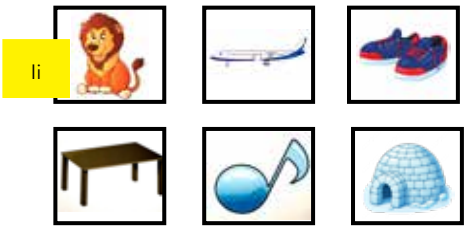
ACTIVE ALPHABET

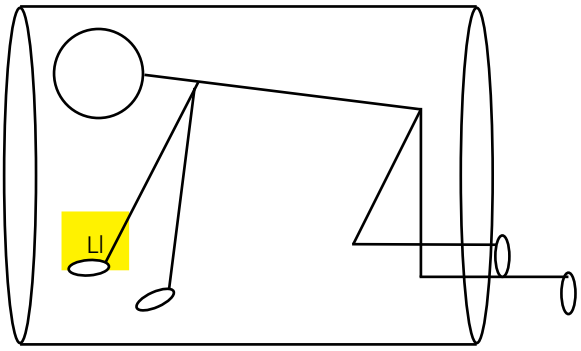
Station 4
Sensory crawling tunnel
letter to image association

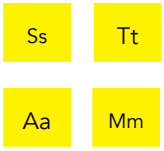
Objectives:
- Full body tactile stimulation
- Develop locomotor coordination
- Increase upper arm and shoulder strength
- Letter to image association

Materials
- 2 tunnels
- 4 gym mats
- 18 image cards and 7 letter cards

Activity Type:
- Locomotor, Tactile







Instructions:
- The objective is for students to match the first letter of a word with the corresponding image.
- Each student chooses a letter and crawls through one of the two sensory tunnels.
- They then place the letter beside the image.
- The letter/image association materials are all dual language compatible allowing the students to choose any tunnel and letter.

ACTIVE ALPHABET

Station 5

Letter writing - hand and body

tracing, writing and yoga letter shapes

Objectives:

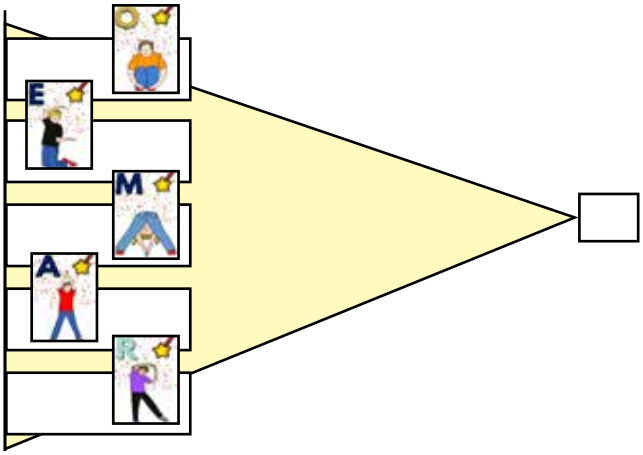
- Building hand strength
- Develop large muscle control
- Increase eye-hand-body coordination
- Recognizing letter shapes

Activity Type:

- Locomotor, handwriting

Materials

- 1 white board
- 1 projector
- 5 whiteboard markers
- 5 yoga mats
- 5 letter yoga pose cards
- 5 letters for tracing



Instructions:

- The objective is for students to learn to recognize and form letter shapes
- Students start by tracing a chosen letter on the white board with their finger
- They then practice writing the same letter with a whiteboard marker
- Finally they go to the yoga mat and create the letter with their full body with the aid of a yoga pose card. Their body shape is projected on the wall so that they can visually see their letter pose.

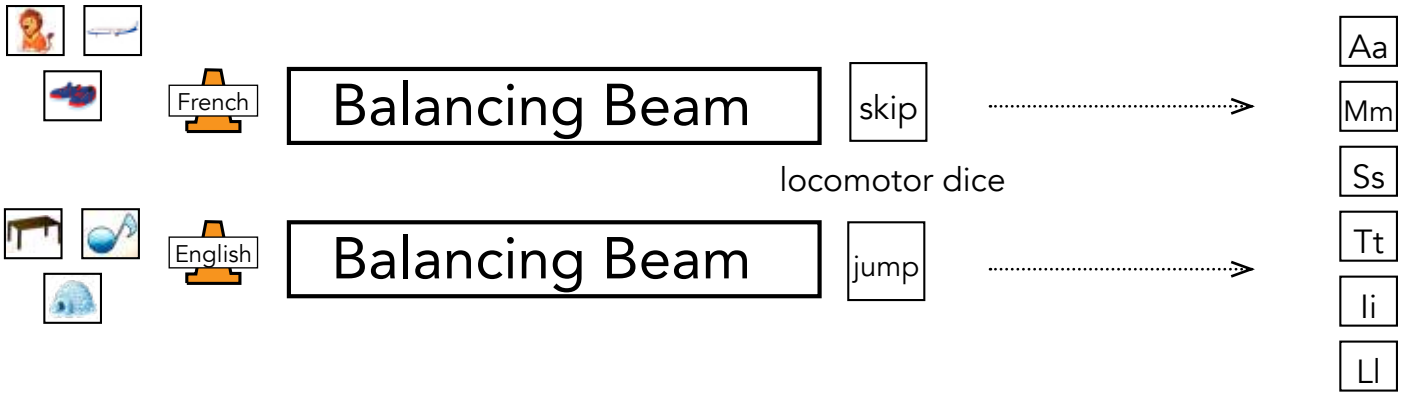
ACTIVE ALPHABET

Station 6
Obstacle course
image to letter association

Objectives:
- Develop motor control
- Improve balance
- Learn locomotor skills
- Image to letter association

Activity Type:
- Balance, Locomotor

Materials
- 2 balancing beams
- 2 cones identifying the French and English line up by using a photo of the classroom teacher
- 2 locomotor dice
- 8 slalom cones
- 16 image cards
- 6 letter velcroed on boxes



Instructions:
- The objective is for students to match the chosen image card and with the initial letter of the word by placing the image in the appropriate letter box.
- Students start by choosing an image and walking across the balance beam.
- They then roll the locomotor dice and do the locomotor action.
- Finally they place the image in the correct letter box.

Appendix 7

Photos and videos during the intervention

Active Alphabet intervention kit

Top left:
Complete set box.

Top right:
Each station has its own box containing all the material necessary

Middle right:
Inside each station box, it is further divided into boxes marked week 1 to week 4

Bottom left and right:
There is a box with all the instructions for each station and extra materials such as stickers to hand out to students once they completed the program

Station 1, 2 and 3

Top:
Station 1: Hopscotch on Polyspots
Literacy focus: Sound, letter name, and word association. 2 lines one for English and one for French as sounds and names are different.

Middle:
Station 2: Trampoline and Teeter Board
Literacy focus: Letter/sound identification and counting syllables.

Bottom :
Station 3: Scooter Board
Uppercase/lowercase letter association.

Station 4, 5 and 6

Top:
Station 4: Sensory Crawling Tunnel

Literacy focus:
Matching initial letter to image association.

Middle:
Station 5:
Letter Writing:
Hand and Body

Literacy focus:
Tracing, writing, and creating full-body letter shapes (yoga)

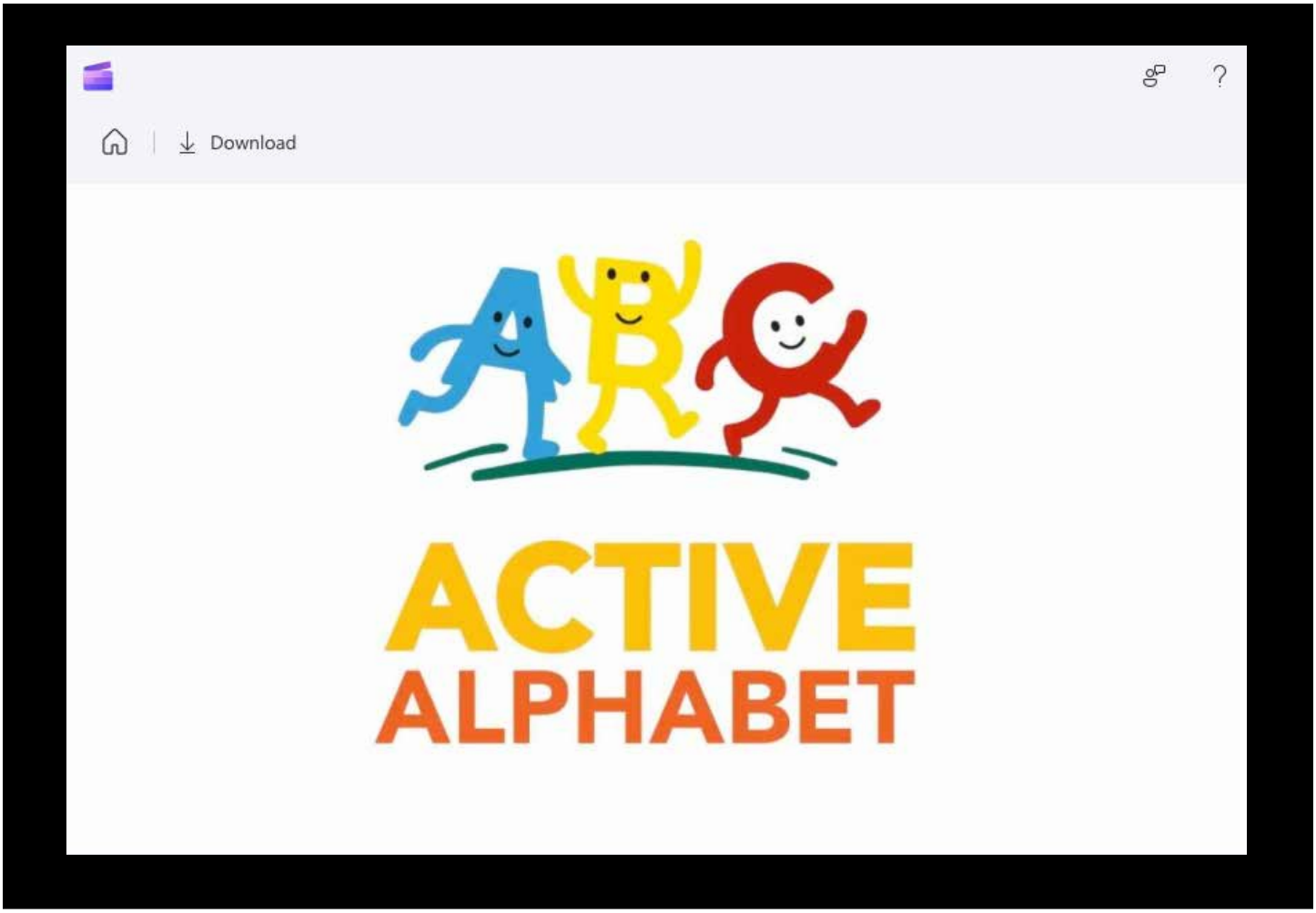
Bottom:
Station 6:
Obstacle Course

Literacy focus:
Match image to initial letter

ACTIVE ALPHABET

Grade 7 student volunteers assist with setting up and running the stations.

Video presentation of program



https://uowtsd-my.sharepoint.com/:v:/g/personal/2413568_student_uwtsd_ac_uk/EVfMf7lT0AJOp-PiI9BikYG4BHC-eF7NfuHOz0Rmxlb_mQw?e=29mRBG&nav=eyJyZWZlcnJhbEluZm8iOnsicmVmZX-JyYWxBcHAiOiJTdHJlYW1XZWJBcHAiLCJyZWZlcnJhbFZpZXciOiJTaGFyZURpYWxvZy1MaW5rli-wicmVmZXJyYWxBcHBQbGF0Zm9ybSI6IldlYiIsInJlZmVycmFsTW9kZSI6InZpZXcifX0%3D