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Designing Science Teaching Materials for Kindergarten Children with ADHD for a Bilingual School

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Abstract

This paper focuses on designing and constructing effective science resources from various materials to support preschool children with attention deficit hyperactivity disorder (ADHD) symptoms. The goal is to motivate learning, help children focus on activities, and reduce ADHD symptoms. The idea stems from the need to support five-year-old students who require more assistance from teachers as they begin formal education. Teachers must ensure both academic performance and overall well-being, necessitating appropriate pre-writing materials. An exhaustive study on preschool children's learning and ADHD symptoms was conducted, consulting relevant authors and studies. The resulting material is a QUIET BOOK with accessories, complemented by a science syllabus to guide teachers in its use. This material was implemented in a bilingual preschool.

Results showed a notable decrease in hyperactivity among students (with or without an ADHD diagnosis) when using the book or accessories. Academic performance improved significantly, and students appeared more motivated for science class compared to other subjects. It is recommended to continue using this material, as it achieves its objective and appeals to the entire classroom, increasing motivation and participation.

Keywords: Attention deficit hyperactivity disorder (ADHD), Preschool Education, Inclusive Education, Teaching resources, Quiet book.

1. Introduction

In pursuing an educational environment characterized by inclusiveness and equal opportunity for all, a crucial question remains: are teachers genuinely fostering a real inclusive environment? Various proposals aimed at promoting an inclusive learning environment are frequently generated. However, these often remain as bureaucratic requirements, seldom translated into practical classroom applications. This gap between theory and practice can be attributed to factors such as time constraints, resource limitations, and a potential lack of a comprehensive understanding of inclusive education principles among educators.

Teachers face the challenge of dealing with the diverse needs of students, especially presented in classrooms with a significant number of early childhood students, where some face attention difficulties, behavioral issues, and low academic achievement. The complexity intensifies when students with symptoms associated with Attention Deficit Hyperactivity Disorder (ADHD) are detected. Addressing the individual needs of students with ADHD in a classroom requires an exhausting job for teachers, especially in preschool, where most of the time those symptoms are attributed to common behaviors of young children according to their age. Therefore, this thesis focuses on the designing and application of teaching resources to work with those students who require more support in the classroom. The aim is to create innovative friendly material that students motivate themselves to use and help them to reach the learning outcomes.

This research emphasizes the importance of science education within STEAM for fostering curiosity, exploration, and critical thinking in young learners. It aims to enhance science education for kindergarten students with ADHD by developing inclusive teaching materials that allow every child to engage and learn at their own pace. Additionally, the project seeks to cultivate environmental awareness, encouraging children to appreciate and protect the natural world, thereby contributing to a reduced ecological footprint.

The initial phase of this project explores ADHD in preschool education, examining theories and studies on how five-year-olds with ADHD process information and benefit from sensory and motor materials. It investigates effective pedagogical strategies and the skills needed for kindergarten science, using the CLIL approach with its focus on Content, Communication, Cognition, Community, and Competences. Three interviews with a preschool psychologist, an occupational therapist, and a bilingual science teacher provide additional insights.

In the second phase, this information guides the creation of suitable teaching materials and a science syllabus tailored to young learners' needs. Designed for broad applicability beyond a single curriculum, the materials support a CLIL-based approach to science education. The project aspires to inspire teachers and enhance inclusive learning, empowering all students and fostering an equitable and enriching classroom experience.

2. Statement of the problem and research question

Primarily, this document aims to address the following question: How can students with ADHD maintain the necessary attention to achieve learning in the science classroom in a bilingual school? At the same time, this project will address how sensory and motor materials contribute to the cognitive development of students with ADHD in preschool settings. Additionally, it will explore how the design of teaching materials based on the CLIL approach can promote inclusivity and equal opportunities for all students, including those with ADHD.

3. Objectives

General objective

To design effective science resources focused on improving learning acquisition and skills development in kindergarten students dealing with attention deficit hyperactivity disorder (ADHD).

Specific Objectives

1. To analyze specific learning challenges in kindergarten education, focusing on difficulties related to ADHD in the classroom.
2. To develop a Science Lesson plan aligned with the science curriculum, based on the CLIL method.
3. To implement the resources and lesson plan in a kindergarten classroom setting, and subsequently, evaluate their effectiveness.

4. Literature review

This session offers an overview of ADHD, covering its causes, symptoms, and effects on early childhood education. It addresses the challenges in diagnosis, the impact of genetic and environmental factors, and the role of sleep disorders. Additionally, it explores effective classroom management strategies, sensory tools, and the use of the inquiry-based science education (IBSE) approach to engage young students with ADHD.

ADHD "is a highly prevalent disorder in the child and adolescent population and is primarily characterized by a persistent pattern of inattention and/or hyperactivity-impulsivity" (Molina et al., 2022, p.58). This condition significantly impacts academic performance, social interactions, and overall quality of life. Individuals effectively. Munch & Radunovich (2012), affirmed that:

- The best estimates suggest that ADHD now affects 0.3–6.5% of all preschool-aged children. ADHD is more common in boys than it is in girls, and it is more common among non-Hispanic whites than in African, American, or Hispanic children (p.2).
- It is important to mention that "kids who have this disorder may show attention problems (e.g., having difficulty focusing), hyperactive behavior (e.g., having difficulty sitting still), and impulsivity (e.g., not thinking before acting)" (Radunovich & Munch, 2012, p.1). Often, this behavior is associated with normal manifestations according to their age. As highlighted by Law et al., (2014) who affirm that "Diagnosis of ADHD in children aged less than 7 years old presents significant challenges to clinicians because many behavioral manifestations of ADHD may be normative at such a young age" (p.660). Although it is not diagnosed during preschool age, children used to show some symptoms, and they tend to become stronger and more evident as they grow.

According to several studies about the main causes of ADHD, "diverse gestational, perinatal, and genetic factors have been associated with ADHD incidence" (Nuñez et al., 2021, p.1). They explain that certain environmental factors during this term, affect different stages of central nervous system development (p. 4). "Premature birth is an important risk factor for ADHD since it has been reported that it occurs 2.6 to 4 times more frequently in babies born with low weight or very low weight" (Nuñez et al., 2021, p. 2). Another cause is Perinatal hypoxia, which occurs when the baby stops breathing. For a certain time after birth. Since conception, babies must receive all the required nutrients to grow healthy; the lack of them during the gestational period is another factor of risk. Nuñez et al., (2021) affirm that another cause could be the alcohol exposure by the father during the preconception and the excessive consumption of sucrose by the mother during the gestation and lactation as well.

Sleep disorders also could lead to ADHD development. "Sleep deprivation, either acute or chronic, produces decreased cognitive functioning (one of the main traits of ADHD). Interestingly, it also produces the externalizing symptoms observed in ADHD patients. For example, a very tired child might become hyperactive" (Nuñez, 2021, p. 3). As an effect, sleep disorders are commonly found in ADHD patients, such as "delayed sleep phase disorders, insomnia, sleep-disordered breathing, increased motor activity during the night, sleep anxiety, clenching teeth, periodic limb movement, restless legs, increased sleep onset latency and shorter sleep time, night awakenings, narcolepsy, and parasomnias" (Nuñez et al., 2021, p.4). Nevertheless, they affirm that "the delayed sleep phase disorder is one of the most frequently found, being present in 73–78% of both ADHD children and adults". This condition involves a misalignment between the sleep propensity cycle, which determines the hours intended for rest, and the circadian cycle, the internal clock signals when the body needs some sleep, "leading to increased daytime sleepiness and decreased cognitive functioning" (Nuñez et al., 2021, p. 4).

Another factor that has an impact on developing ADHD is genetics. Two genes are linked to cause ADHD: a neurotrophic (brain-derived neurotrophic factor, BDNF) which has an important role in neuronal development, being important for neuronal proliferation, migration, differentiation, and maturation, and a molecule involved in Dopaminergic signaling which is the process where dopamine, a neurotransmitter, communicates between neurons in the brain. This type of signaling plays a crucial role in various functions including movement, reward, motivation, and regulation of mood. (Nuñez et al., 2021, p. 4)

ADHD in the Classroom

It is commonly hard for teachers to deal with students presenting ADHD symptoms. Many of them use a reinforcer that according to Riga et al. (2017) "is a type of reward given for the completion of a task or for engaging in an appropriate behavior such as being on task. This may refer to either the child's verbal reward or the material and symbolic one".(p.9) A reward system can be highly effective in leading children to complete tasks or engage in appropriate behavior.

There are some other changes that teachers must consider providing equal opportunities for participation and learning in the classroom. For example, use Multisensory Integration (MSI) which is the association of all senses that work independently and together to perceive stimuli in the surroundings (Dionne-Dostie et al., 2015, p.35-36).

Although children experiencing ADHD present a variety of symptoms such as aversion to loud sounds, specific textures in clothing or food, and particular tastes and smells, it is recommended to provide sensory tools and didactic resources if the child accepts. These resources help maintain their attention, motivate them, and enhance their interest in the content or subject matter. Sensory tools can provide tactile, auditory, and visual stimuli that engage children with ADHD, helping them focus and better understand the material presented (Tacuri, 2021 p. 54). A further study made by Lin HY et al. (2014) demonstrated that the use of weighted vests and stuffed weighted objects helped participants to show significant improvement in inattention (p.1); "the speed of processing and responding; consistency of executive management; and some on-task behaviors, including off-task, out-of-seat, and fidgets" (p.1). Tacuri (2021) affirms that "Implementing entertaining games incorporating different body parts and, where feasible, utilize props such as plastic animals, fruits, chips, and plush toys" (p.54). In other terms, to ensure progress and a successful process toward more formal tasks, such as completing worksheets or utilizing notebooks, it is crucial that they first engage with tactile materials.

ADHD diagnostic process at school

"Early childhood students facing ADHD have poorer neuropsychological functioning related to their typically developing peers" (Rajendran et al., 2013 p.2). In addition, constant displays of associated

symptoms serve as a clear alert for caregivers and educators in the school environment who support the educational process. According to a description of the process found at Radunovich & Munch (2012), is common that Teachers typically initiate a procedure that begins with observing the behavior in the classroom. Subsequently, dialogue with parents ensues to gather insights into the student's behavior in other contexts, both within and outside the home. Teachers should ask for support from the school's psychology department (if available), in collaboration with coordinators, arrangements are made for a referral to external psychology services for diagnostic assessment (p.1-3). While awaiting recommendations from experts, teachers must devise strategies to assist students in their process.

Classroom management strategies for ADHD children

One of the most common concerns teachers have in the classroom is disruptive classroom behavior, which certain students may show during classes. Previous research indicates that ADHD occurs more often in males than in females, and behaviors can be different in boys and girls. For example, boys may be more hyperactive, and girls may be quietly inattentive. Research conducted by Young et al. (2020) compares the symptoms shown by boys and girls with ADHD. Symptoms in girls are often less prevalent, especially regarding hyperactivity or impulsiveness. Girls tend to appear more distracted, disorganized, overwhelmed, and lacking in effort or motivation (p. 4).

Martel (2016) explained three subtypes of ADHD: the predominantly inattentive where children are not capable of organizing themselves or finishing a task they have started. It is difficult to follow instructions or a conversation. They are easily distracted and usually forget the details of their daily routine. On the other hand, the second subtype is Hyperactive-Impulsive. Predominantly, kids fidget and talk a lot, and kids deal with a lack of still sitting for long, they jump, climb, and run constantly. Frequently they are prone to accidents and injuries due to their constant movement. Finally, the combined presentation of ADHD is a mix of inattentive symptoms and Hyperactive/impulsive symptoms are considered another subtype (p.1-2). Martel also affirmed that "symptoms can change over time and presentation may change over time as well" (2016, p.1-2)

There are certain strategies and methods that teachers can apply to reduce attention and hyperactivity issues. Segal & Smith (2024) propose that teachers can integrate the following three components: "Accommodation is the synonym to flexibility, what a teacher does to make learning easier for students with ADHD. Give shorter and clearer instructions. The teacher needs to maintain a positive attitude and help the student to get the work done. Another functional tip to put into practice is to sit the students away from windows and doors. Use visual charts and color coding. Create a worksheet with fewer items and test with a reduced number of questions. Divide long-term projects into segments and assign a completion goal for each segment. The teacher can help the students change the strategy to evaluate whether orally or by filling in blanks (p. 1-2).

Help the student keep their space organized before, during, and after tasks. Offer guidance on how to arrange materials and maintain an orderly space. Praise and reinforce good behavior or successful work with encouraging words and rewards.

It is important to "Have an unobtrusive cue set up with the student who has ADHD, such as a touch on the shoulder or placing a sticky note on the student's desk, to remind the student to stay on task. Allow a student with ADHD frequent breaks and let him or her squeeze a rubber ball or tap something that doesn't make noise as a physical outlet." (Segal & Smith, 2024 p.2-3).

The Role of Sensory Materials in Education for ADHD

Ashburner et al. (2008) conducted a comprehensive study that examined the relationship between sensory processing and classroom outcomes, particularly for children with neurodevelopmental

disorders, such as ADHD and autism. Their findings revealed that «children who exhibited higher levels of sensory processing difficulties also displayed more behavioral challenges in classroom settings» (Ashburner et al., 2008, p. 568). This suggests that sensory issues directly correlate with disruptive behaviors, such as inattention or hyperactivity, which are commonly seen in children with ADHD.

The study emphasizes that sensory-rich environments, which include materials that offer tactile, visual, or auditory stimuli, can help reduce these disruptive behaviors. According to Ashburner et al., «When children were provided with sensory input tailored to their needs, improvements were noted in both their ability to regulate their emotions and in their overall classroom behavior» (p. 570).

By using soft materials such as felt, which offers a range of textures and tactile sensations, create a tool that can help calm and focus students.

Schaaf and Davies (2010) provide a comprehensive review of sensory integration theory, which highlights that "tactile and proprioceptive inputs are critical for children with sensory processing.

Disorders to regulate their behavior and focus their attention» (p. 365). The research conducted by Johnson & Brown (2020) emphasizes the use of sensory-rich materials and adaptive seating to support primary school students with ADHD, noting that these interventions have led to increased focus, reduced hyperactivity, and improved social interactions. Johnson & Brown (2020) expand on this by showing that sensory strategies adapted to students with ADHD result in «significant improvements in both behavioral regulation and academic performance» (p. 63).

Teaching science in kindergarten

Young children exhibit a strong propensity for exploration and discovery. They use to explore the environment and get to know some characteristics of animals, plants, and their own body through their senses. "Therefore, the field of biology seems to be naturally appropriate for engaging preschool children with science" (Flores, 2022, p. 3). They start to acquaint themselves with their surround before being enrolled in school. "Basic ideas are the starting point and prerequisite for further learning, as they represent the knowledge base upon which conceptual development and reconstruction takes place" (Flores, 2022, p.42). These preconceptions are useful since they are already motivated enough to contrast their ideas with peers; furthermore, they provide the basis for a more formal construction of solid concepts. At this point, a pressing question arises for teachers when deciding on a strategy to implement in science classes aimed at the preschool population that will benefit their proper cognitive development. This is when the idea emerges to implement a method that has recently been mentioned in several studies on science education: Gerde et al., (2013) propose the inquiry-based science education approach.

Inquiry-Based Science Education Approach

Inquiry-based science education approach was chosen to engage science in preschool education. According to Ergazaki & Zogza (2013,)

This approach differs from the scientific method, enhances the "joy of learning, and favors the development of curiosity and creativity. The IBSE (inquiry-based science education) includes the next key elements mentioned in their research. The experience based on previous knowledge, and understanding of a problem, development of basic scientific skills like observation, development of reasoning and argumentation, use of resources, and collaboration" (Ergazaki & Zogza, 2013, p. 75). Teachers should lead and help students to support the process as they design experimental tests, analyze data, and formulate conclusions. As is reinforced in Trna et al. (2012) "Students themselves suggest procedures to verify the inquiry questions and their subsequent solutions. Students are encouraged by the teacher much less than in the previous two levels, which radically increases their level of independence" (p.3).

Image 1 illustrates the sequence to follow for an effective science lesson using (IBSE).

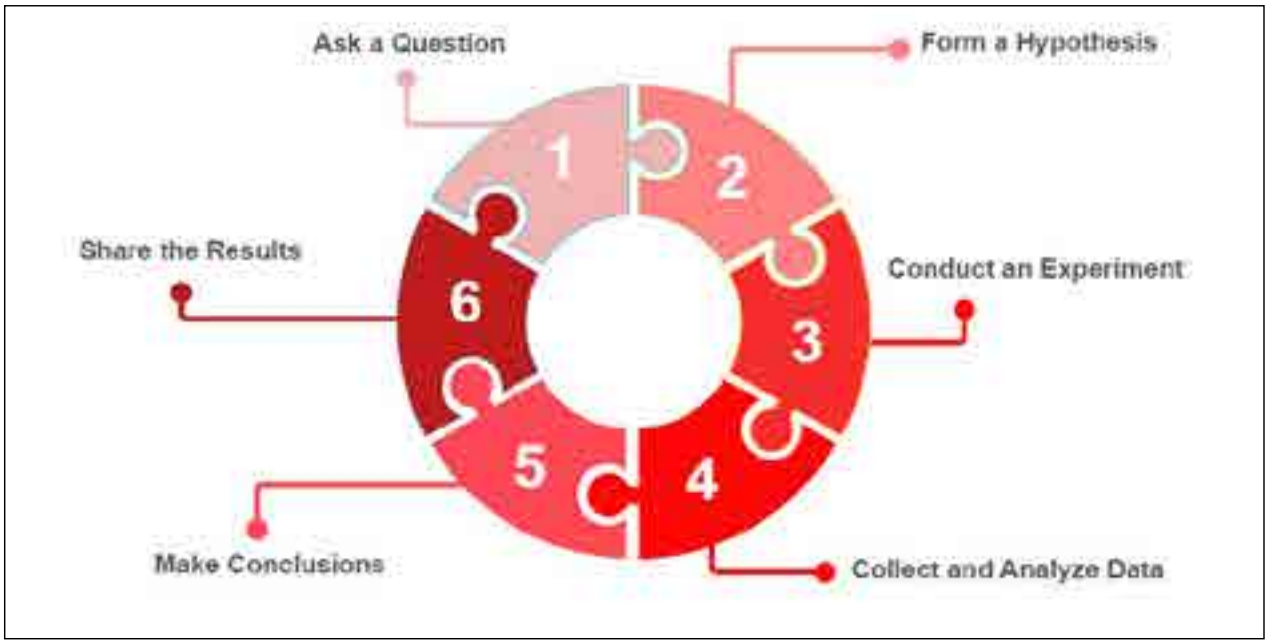

Figure 1 *Inquiry-Based Science Education (IBSE)*

Source: Own contribution (2024). Design by PresentationGO.com

Main concepts to develop in science lessons

Early science education stimulates natural curiosity and a love for learning. Through questions and observation, young children tend to develop curiosity, which will allow them to have a passion for learning, exploring, and innovating. Anderson & Gullberg (2014) affirm that Children's participation in scientific activity is beneficial because it allows them to engage as active agents in their learning process, even though they don't gain conceptual knowledge (p.1-3).

According to Flores (2022) "A domain that seems naturally appropriate for preschool children is the field of life sciences. Throughout their everyday life, young children gather various experiences with animals, plants, and processes in the human body". (p.47)

Another important concept to develop at this early age is the relationship between structure and function, which can be imparted using different scientific content. In this work, it will be applied two different cognitive processes that Flores (2022) argues:

The first dimension represents the cognitive process called recognition; it reflects children's ability to match biological structures with their respective functions. The second dimension represents the cognitive process called explain; it reflects children's ability to describe and explain how the features of a specific biological structure allow it to fulfill its function (p. 22).

Simple activities that can be significant could be easy experiments based on the concept of sink or float where students make predictions about biological phenomena and first give a hypothesis of what would happen if they put an object (or material) on the water, will it sink or will it float? Invite them to wonder about themselves, and listen to other's opinions. (p.45)

5. Theoretical Framework

The theoretical framework is grounded in CLIL, Vygotsky's sociocultural theory, Bloom's taxonomy, Ausubel's learning principles, Piaget's cognitive development, Montessori sensory learning, and operant conditioning to support bilingual education and address the specific needs of students with ADHD.

Learning Theories in CLIL

Producing effective teaching material for a bilingual CLIL (content and language integrated learning) classroom is factual to make a general revision of the research made by Coyle et al. (2010) where SLA Theory and CLIL approach are summarized, highlighting previous works. Coyle affirms that CLIL is "a dual-focused educational approach in which an additional language is used for the learning and teaching of both, content and language" (p. 1). It has been applied for decades in different content areas and for certain purposes in teaching or learning a foreign or second language. Nevertheless, due to the demands of current globalization, socioeconomic convergences have allowed the teaching of different languages to be implemented through this methodology in several countries. Gabillon (2020) sustains that according to previous research, CLIL's first aim was to innovate in foreign language teaching, promoting plurilingualism in Europe, they got the idea from the success of previous bilingual immersion programs. (p. 90) One of the most relevant theories that support CLIL is the sociocultural Theory; Vygotsky (1978, 1986), as cited in Gabillon (2020), considered "cognitive development and knowledge acquisition as a social construction that is developed with social collaboration" (p. 98). He claimed that optimal cognitive development depends upon the 'zone of proximal development' (ZPD), where individuals construct the new knowledge through socially mediated interaction" (p. 98). In a CLIL classroom, the teacher employs the target language to deliver instructional tools. Concurrently, students receive input in this language and complete tasks utilizing it. According to Vygotsky (1978), as cited by Gabillon (2020), scaffolding is used to provide guidance as students progress in their learning journey. The instructor supports this process by gradually increasing the difficulty level, ensuring that students can successfully navigate and master new concepts (p. 98).

In addition, it is important to revise CLIL (content and language-integrated learning)-standards for designing effective material. Mehisto (2012), provides complete criteria for creating CLIL resources that include useful strategies to build teaching materials based on the complexity of teaching in a bilingual classroom and considering the scaffolding according to the level of students and their progress (p. 15).

Ausubel cited in Bryce & Blown, (2023) "inspired several lines of research into school learning and instruction when he formalized the view that people learn new ideas by building on their own current knowledge" (p. 4580). This theory underscores the importance of learners engaging with new information in a way that connects it to their existing cognitive structures, thereby facilitating deeper understanding and retention. "Learning occurs when learners actively construct or create basic information by themselves, as they do through inquiry and discovery" (Saleem et al., 2021, p. 404) Agreeing with constructivist principles, which advocate for learning environments that encourage exploration, critical thinking, and the integration of new concepts with prior knowledge.

In 1956, Bloom cited in Gabillon (2020), provided an equivalent idea when he set a list of specific parameters that learners need to develop to get their knowledge construction, it receives the name of Bloom's Taxonomy which is a "classification of levels of intellectual behavior important in learning" (Tee et al, 2015 p.3).

According to Widad & Kandar (2006), cited in Tee et al. (2015), "Bloom identified six levels within the cognitive domain, from the simple recall or recognition of facts, as the lowest level, through increasingly more complex and abstract mental levels, to the highest order which is classified as evaluation" (p.3). Bloom's Taxonomy represents a hierarchical framework for categorizing educational objectives.

In 2001, Anderson et al. defined metacognitions as an understanding of cognitive processes in general, with an awareness and insight into one's cognitive activities (p. 2).

According to Tee et al, (2015), "The major differences in the updated version is in the more useful and comprehensive additions of how the taxonomy intersects and acts upon different types and levels of knowledge -- factual, conceptual, procedural and metacognitive"(p. 4). Table 1 illustrates the different levels of Bloom's Taxonomy, detailing each level's characteristics and providing a set of actions that pre-

school learners might perform at each stage. The table also includes examples demonstrating progression from simple to complex cognitive tasks, illustrating how each level builds upon the previous one to guide students through the learning process.

Table 1 *Summary of the definition of Bloom's Taxonomy*

Level	Description	Example
Remember	The ability to recall basic facts and concepts. Identify, List, Name, Recognize, Recollect, Match, Describe.	Let's match the animals with their names.
Understand	The ability to explain ideas or concepts. Explain, Discuss, Describe, Compare, Illustrate, Summarize, Interpret.	Let's compare apples and bananas.
Apply	The ability to use information in new situations. Use, Demonstrate, Perform, Execute, Apply, Show.	Let's pretend to go to the farm and milk a cow.
Analyze	The ability to break down information into parts and examine relationships. Analyze, Organize, Differentiate, Examine, Categorize, Classify.	Can you organize these foods into fruits and vegetables?
Evaluate	The ability to make judgments based on criteria. Judge, Evaluate, Assess, reflect, Justify, Compare, Decide.	Which snack is the healthiest? Let's evaluate our choices.
Create	The ability to put elements together to form a new whole. Create, Design, Construct, Develop, Invent, Formulate, Plan.	Can you create a collage using these materials?

Source: Adapted from Anderson et al., 2001

Piaget's Theory of Cognitive Development

It is important to address Piaget's theory where he focused on children's cognitive development; In other words, this theory explains how people think as they progress from infancy through childhood to adolescence and ultimately into adulthood. Individuals progress through a series of four developmental stages of thinking. The first stage, known as the Sensorimotor Stage, spans from birth to 2 years old. During this period, knowledge is primarily acquired through sensory experiences and motor activities. Infants learn about the world by touching, tasting, and moving objects around them. Initially, infants believe that if they cannot see an object, it no longer exists. This stage is crucial for the development of cognitive processes and the foundation of future learning.

From two to seven years old, the preoperational period occurs; children acquire knowledge primarily through direct experiences and interactions with their environment. They engage in pretend play, use symbols to represent objects, and begin to develop language skills. Additionally, they struggle with understanding abstract concepts and require concrete, real-world situations to learn effectively. The stage is crucial for building the foundation of logical thinking and setting the stage for more complex cognitive processes in later stages.

The preoperational stage is particularly significant because of the development of language skills, encompassing both the child's native language and any additional languages they may be learning. To foster optimal language acquisition, it is essential to provide children with a rich array of tangible experiences that not only support cognitive growth but also enhance their ability to understand and use language in meaningful contexts.

Sensory Learning and Educational Methods

Dr. Montessori was a physician, educator, and innovator who focused on children's development and learning processes. According to Luborsky (2017), "Dr. Montessori's educational approach supports the development of executive, cognitive, and other academic foundation skills as well as motor, language, social, and sensory skills" (p. 21). She states that "a classroom is a place where children could embark on their voyage of discovery. Emphasizing that sensory items, materials, and tools are within the child's reach, allowing them to be manipulated and used to get a "neurophysiological workout" (Luborsky, 2017 p. 22), which refers to activities or exercises designed to stimulate and enhance the functioning of the brain and nervous system. These workouts aim to improve certain cognitive and physical abilities by targeting the neurological pathways that control them such as memory training, problem-solving tasks, motor skills development, and sensory integration activities promoting brain plasticity. Dr Montessori worked on an ongoing process of experimentation through observation and modification. She prepared a setting with a series of materials with which children had to interact. Those materials "would incite engagement, exploration, repetition, and learning" (Luborsky, 2017 p. 22). Nevertheless, if the child were not interacting with certain elements, she would change them until "she felt that she had materials that engaged the full personality of the child in deep, concentrated work" (Luborsky, 2017, p. 22). It is suggested that:

Given that reality, it is incumbent on us to enrich the sensory and motor opportunities in the classroom and the outside environment. Outdoor and indoor play opportunities that allow children to run, jump, climb, crawl, roll, and just move, in general, deserve special attention as our physical environments are designed. Montessori recognized the vital role of movement.

Sensory Processing Disorder (SPD) is an issue generated in the Nervous system that receives and processes incoming sensory information to understand external elements and respond to environmental factors appropriately. According to Luborsky, (2017):

- SPD affects a child's readiness for learning, impairs successful social interactions, disrupts family dynamics, hinders self-regulation, and interferes with attention".
- SPD is divided into three subtypes: sensory modulation disorder, which addresses the kid that is constantly seeking sensory stimuli; sensory discrimination disorder, which involves the lack of establishing a difference between a texture from another; and Sensory-motor disorder which is the difficulty of planning and executing movements effectively. (p. 310)

Sensory Integration Theory is based on the idea that the brain processes sensory inputs from the environment to allow individuals to make sense of their surroundings and respond appropriately. When this process is disrupted, it can lead to difficulties in behavior, learning, and emotional regulation.

Faramarzi et al. (2016) expanded upon this theory, particularly in the context of children with Attention Deficit Hyperactivity Disorder (ADHD) highlighting that children with ADHD often exhibit sensory processing issues, they may either be hypersensitive or hypersensitive to sensory stimuli. These sensory processing challenges can exacerbate the core symptoms of ADHD, such as inattention, hyperactivity, and impulsivity.

Faramarzi et al. (2016) propose that sensory integration therapy, which involves activities designed to improve the brain's ability to process sensory information, can be particularly beneficial for children with ADHD. By addressing sensory processing issues, it is required to include techniques and resources to help children improve their focus, self-regulation, and overall behavioral responses.

In their study, Faramarzi et al. (2016) found that children with ADHD who underwent sensory integration therapy significantly improved their ability to manage sensory input and a noticeable reduction in hyperactive and impulsive behaviors. This suggests that incorporating sensory integration therapy into

daily activities for children with ADHD can enhance the effectiveness of more traditional approaches, such as behavioral therapy and medication.

Dr. Barkley (2014), a leading expert on ADHD, has made significant contributions to understanding how structured environments and directed interventions can improve outcomes for children with ADHD. In his work, He highlights the importance of creating structured, supportive environments that provide consistent, predictable routines to help manage ADHD symptoms.

The use of Quiet Books aligns closely with Barkley's principles as he emphasizes that children with ADHD benefit from environments that are not only structured but also responsive to their sensory needs. Tactile, sensory-rich materials such as felt can offer the kind of structured stimulation that helps maintain attention. Barkley states, "Children with ADHD often require environmental modifications that can help them filter out distractions and focus on tasks" (Barkley, 2014, p. 347).

Brown (2005) has a similar perspective on these useful materials in the classroom. He supports that "Children with ADHD often benefit from engaging in hands-on, sensory-rich activities that help them stay grounded in the learning process. By giving their brains something concrete to focus on, such activities can minimize distractions and improve their ability to retain information" (p. 153).

Operant Conditioning in ADHD Management

Operant conditioning can be effectively applied to encourage desired behaviors and reduce problematic ones in a preschool setting, where children with ADHD often struggle with attention, impulse control, and behavioral regulation.

According to Skinner (1953) "A person who has been reinforced for behaving in a given way is more likely to behave in that way again". Positive Reinforcement involves introducing a rewarding stimulus after a desired behavior is exhibited, increasing the possibility that the behavior will be repeated. For preschool children with ADHD, positive reinforcement can be very effective. One of the most common is to praise verbally acknowledging a child when they follow instructions or complete a task. For example, «Great job sitting still during story time!» Another option is to provide small rewards, such as stickers or extra playtime when a child completes a task or demonstrates good behavior.

6. Methodology

This research employs a qualitative methodology, combining literature review, interviews, and the development of a science didactic unit for kindergarten. The literature review focuses on the design of didactic resources, especially for ADHD children, and the integration of science and didactic materials. Interviews with experts, revision of ADHD, learning styles, occupational therapy, motor development, and sensory materials. The developed science unit, aligned with 21st-century skills, draws inspiration from previous research and a teacher interview to address the specific needs of kindergarten students, particularly those with ADHD.

7. Didactic proposal

A Science Quiet Book was designed to stimulate students with ADHD through sensory engagement. This book, made from soft materials and filled with various textures and weights, aims to increase attention span and concentration. It incorporates science content and 21st-century skills, providing a multisensory learning experience.

The Quiet Book is complemented by five lesson plans covering themes such as the human body, senses, and nutrition. Each lesson includes a structured routine, a warm-up activity, and hands-on tasks

aligned with Bloom's Taxonomy and the Inquiry-Based Science Education Approach. (IBSE). The activities are designed to engage students with ADHD, incorporating Montessori's multisensory approach and Vygotsky's Zone of Proximal Development. The lessons promote inquiry-based learning, social interaction, and cognitive development.

Lesson 5 is attached as an example.

Table 2 *Lesson plan 5: Source: Own contribution (2024).*

Session 5	Contents	English for Sciences
Plants and food Where does the food come from?	Story: The Little Red Hen Animal or plant origin of food	Determine how to make bread through a story. Analyze where the food comes from. Plant a seed or a small aromatic plant.

Course:	Kindergarten	Date:		Duration:	120 minutes
Language (communication, vocabulary, structures)	**Vocabulary:** Animals: Duck, cat, mouse, dog, hen Verbs: grown, water, thresh, ground, eat, chicks. Food: Buns, flour, wheat, patty, beef, protein, cheese, tomatoes, lettuce, onions, pickles. **Food vocabulary:** Grain of wheat, flour, loaf of bread, Recycling: Hen, cow, sheep. Farm, Wool, milk, shear, Clay Flowerpot mint, basil, rosemary, coriander **Language:** "Not I, said the duck" Who will…? Is a hamburger healthy? Is the cheese healthy? Is it unhealthy What are you doing? I'm milking the cow. I'm shearing the sheep. I'm collecting eggs. Water the plants every day.				

8. Session Flow

Opening Routine (10 minutes)

Placing the date and weather on the board and in the Quiet Book Sing a song "The greeting song by Maple Leaf Learning" (2012). Warm-up (10 minutes)

Start the lesson by going outdoors. Using the resources in the Quiet book to tell the story "The Little Red Hen".

Invite the students to repeat some patterns from the story while holding the finger puppets, and repeat their lines.

Figure 2 *Quiet Book Page, The Little Red Hen Finger puppets*
Source: Own contribution (2024)

Activity 1 (30 minutes)

Ask the students: Where does your food come from? Elicit some answers from the students and explain that today they will do some activities around them.

Show the video: where does a hamburger come from? By the Children's Hand-on Museum (2021).

After watching the video, remove the hamburger parts from the Quiet Book. Have students name each ingredient and remind them where each ingredient comes from.

Figure 3 *Quiet book Hamburger*

Source: Own contribution (2024)

Give each student a paper sheet with ingredients for a hamburger. They classify the healthy and unhealthy ingredients. Bear in mind to repeat the ingredients as they form their own hamburgers.

Inclusive activity: The student works in the same activity, but he/she uses the didactic book first and then he moves to the guide. He has the Felt hamburger on the desk, and he is free to use it.

Figure 4 *Felt book page, Where food comes from*

Source: Own contribution (2024)

Set on the board some pictures faced down. States that they are going to match the food and its origins. Ask a student to go to the board and flip a picture from line 1 and another from line 2. If the food matches with the animal or plant where it comes from, he/she gets a point.

Inclusive activity: Student works in the same activity using the Quiet Book.

Activity 2 (30 minutes)

Anticipate the students to the next activities by saying that they are going to visit a farm. Previously, it was important to prepare four different stations for kids to do different things.

- In station one, sing the song Old McDonald Had a Farm super simple song (2013)
- In the second station they milk the cow Lola meanwhile they sing the song our cow Lola (PinkFong, 2021).
- In station 3, collecting eggs. Divide the class into groups of three students, give a basket, and hide some toy eggs around. They should pick up the eggs.

Finally, in station 4, in groups of three, students are going to shear a sheep. Students use a paintbrush to shear the shaving cream from the sheep into the bucket.

Inclusive activity: The student does these three sensory activities.

Figure 5 *Collecting eggs*
Source: Own contribution (2024)

Collaborative / outdoors activity (20 minutes)

Personalize a flowerpot.

Inclusive activity: The student does the same activity using paintbrushes or finger paint. Wrap up (20 minutes)

Sensory Garden: Create a sensory garden where children can touch, smell, and learn about different plants and their uses.

Ask students to take care of their plants, set a set hour of the day to water the plants, take them out of the classroom, and monitor their growth.

Figure 6 *Decorating a plastic flower pot*
Source: Own contribution (2024)

9. Results

This research focused on creating science resources for kinder-garten students with symptoms of hyperactivity or attention disorders to aid in skill development and learning. The study was implemented in two kindergarten classrooms at La Salle School, a bilingual institution implementing CLIL methodology. Classroom A had three students needing additional support, including one.

Diagnosed and undergoing treatment, while Classroom B included two students with possible autism symptoms currently being evaluated.

A total of five students, four boys, and one girl, required targeted attention. Consistent with research by Munch & Radunovich (2012), boys displayed ADHD symptoms more frequently than girls. Lessons

using the felt book took place over five sessions in Classroom A and three in Classroom B, with teachers integrating the book into lesson plans.

In feedback, applied through an interview, teachers suggested improvements, such as providing enough Quiet Books for all interested students, including those without ADHD, and creating similar resources for other subjects, like mathematics. They also recommended including additional sensory materials, such as weighted items, to aid students in maintaining focus.

Overall, the Quiet Book positively impacted attention, engagement, and fine motor skills, fostering a more inclusive classroom environment. Teacher feedback and student improvements supported the hypothesis that sensory resources effectively aid students with ADHD in focusing and enriching their learning experiences.

10. Conclusions

This study designed and implemented a felt book as a sensory resource to address the educational needs of kindergarten students with ADHD symptoms, specifically within science lessons in a bilingual classroom setting. Recognizing the challenges these students face in maintaining focus and managing hyperactivity, the research aimed to improve their learning experience and overall classroom environment. The felt book was created with sensory elements, including varied textures, colors, and weights, inspired by Montessori's sensory principles and Faramarzi's sensory integration theory. Extensive input from specialists—a psychologist, a science teacher, and an occupational therapist—guided its design to ensure it would meet the specific attention-related needs of students with ADHD.

The felt book was implemented in two kindergarten classrooms at La Salle School, a bilingual institution with over 10 years of experience in the CLIL methodology. Approximately 80% of students responded positively, showing improvements in focus, engagement, vocabulary acquisition, and fine motor skills. Teachers were eager to integrate the felt book into their classes, noting it as a highly effective tool for managing hyperactivity and enhancing attention. The book's activities, such as buttoning, unbuttoning, and threading, particularly supported students' motor development, with all students showing improvement in this area. Sensory aspects of the felt book further encouraged inclusivity by engaging students of all needs, creating a more supportive and motivating learning environment.

Alongside the felt book, five structured science lesson plans, referred to as «session plans,» were developed to guide its integration into the curriculum. These plans aimed to facilitate active participation and achieve specific learning outcomes in science, especially for students with ADHD. Teachers and assistants who applied the felt book and session plans reported that it helped maintain attention, enhance engagement, and improve motor skills. Additionally, the use of weighted sensory items, such as snakes, effectively reduced hyperactivity in most students, allowing them to stay seated and focused.

A survey distributed to teachers and assistants provided direct evidence supporting the hypothesis that sensory materials like the felt book can improve attention, learning engagement, and overall classroom environment for students with ADHD. Key findings indicated that 80% of students with ADHD symptoms attended three or more sessions with sensory materials, showing marked improvements in focus and motivation. Teachers observed that these resources promoted inclusivity, increased engagement, and boosted students' confidence in completing assignments.

In conclusion, the felt book proved to be a valuable sensory tool that enhanced attention facilitated learning, and contributed to a more positive and inclusive classroom atmosphere. The success of this project demonstrates the effectiveness of sensory resources in supporting the unique educational needs of students with ADHD, highlighting their potential to improve focus, engagement, and classroom dynamics in early childhood education.

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