‘STREAM’ Laboratory School for the Early Years

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Foreword

It is with great satisfaction that we present this report, a product of collaborative efforts ignited by the Regional Policy Dialogue on Early Childhood Development (ECD) convened by the Inter-American Development Bank (IDB) in 2015. In response to the resounding call for action voiced during this dialogue, the Ministry of Education, Technological and Vocational Training (METVT) in Barbados embarked on a transformative mission to elevate the teaching and learning of Science, Technology, Reading, Engineering, Arts, and Mathematics (STREAM) at the ECD level.

At the heart of this report lies a bold vision to establish a STREAM-Focused Laboratory School within the educational landscape of Barbados. This vision transcends mere theory, finding solid ground in practical implementation, supported by the technical cooperation grant entitled 'Getting an Early Start in Science, Mathematics, and Literacy: Creation of a LAB School for Early Childhood Development (BA-T1053)', approved by the Inter-American Development Bank (IDB) in 2018. The grant provided the resources required to launch a pilot intervention at the Maria Gall Hill ECD Center in collaboration with the Erdiston Teacher Training College, laying the foundation for pioneering pedagogical practices to flourish.

Contained within these pages is a roadmap meticulously crafted to steer future endeavors in the establishment of STREAM-focused Lab Schools at the ECD level. This roadmap is a testament to rigorous research, collaborative ideation, and an unwavering commitment to delivering the highest quality education to our youngest learners.

At the core of our approach lies the profound recognition of play-based learning as an indispensable pillar of early childhood education. We delve into the transformative power of play in nurturing curiosity, fostering creativity, and honing problem-solving skills essential for success in STREAM subjects. Furthermore, we underscore the imperative of a pedagogical shift towards play-based methodologies, advocating for environments that encourage exploration and collaboration.

In addition to theoretical insights, this report offers pragmatic recommendations for the selection of learning materials and emphasizes the paramount importance of continuous professional development for educators. We firmly believe that arming teachers with the requisite knowledge and skills is pivotal in unlocking the full potential of STREAM-focused Lab Schools.

As we embark on this journey towards educational excellence, we extend our heartfelt gratitude to all stakeholders for their dedication to shaping the ECD LAB school. May this report inspire future initiatives aimed at enriching the lives of our youngest learners and illuminating the path toward a brighter, more innovative future.

Maria Mercedes Mateo-Berganza Diaz
Chief of the Education Division, IDB

1. Laboratory Schools: An Introduction

Laboratory schools, or "lab schools," were originally introduced to provide students and researchers with an environment where they could observe and conduct research with children in a natural environment. They are generally associated with a college or university where both pre-service and in-service educators can learn and model best practices in early childhood education. Essentially, the purpose of lab schools is to provide a bridge between theory and practice and ultimately create a system of high-quality preschool programs. Research indicates that quality preschool programs have a positive influence on young children's development and learning (OECD, 2018). The definitions and perspectives of high quality in an early learning setting can vary from country to country, reflecting different cultural values, systems, and concepts of childhood. However, as identified by the Organization for Economic Co-operation and Development (OECD) in their 2018 study of nine participating countries, the following factors help to determine the quality of early childhood education and care:

- Quality interactions between children, staff, and parents/guardians in early childhood education and care settings, specifically interactions that support children's socioemotional and language development, as well as activities that support all aspects of child development.
- Qualified teachers, assistants, and leaders who participate in ongoing professional learning. According to Doherty, Lero, Goelman, LaGrange, & Tougas (2000), the ECE-specific qualifications of staff are the primary indicator of quality in early learning programs.
- Structural features of quality environments, such as location, size, and type of building, as well as the number of teachers per child (adult-to-child ratio) and group size, with lower adult-to-child ratios being seen as conducive to higher quality care and education.

To this end, laboratory schools have a three-part mission: teacher education, research, and service. Specifically, according to Saracho (2019), teacher education or professional prepa-

ration prepares educators and other related professionals to support the development of young children. The research conducted at a lab school aims to generate knowledge about early childhood education and early learning. Finally, the service component means that the lab school provides quality early learning and childcare programs to children and families, and it offers information and resources to parents and the general public.

2. STREAM-Focused Lab Schools

"Young children are very curious! They seem to be born with an eagerness to learn about the world around them. Adults often refer to children as 'sponges' to highlight the way children seem to soak up experiences and knowledge in what appears to be an effortless way."

(Red River College/Science of ECD[1].)

The acronym 'STEM' refers to Science, Technology, Engineering, and Mathematics. In the early years of a child's education, this acronym is sometimes extended to STREAM, adding an 'R' for Reading/Literacy, and an 'A' for art, acknowledging the holistic way that young children learn about and experience the world around them.

The skills associated with STREAM – observing, exploring, questioning, predicting, discussing, describing, and experimenting – are foundational to lifelong learning, all with their beginnings in childhood. Specifically, these skills are supported through play. When children are provided with engaging classrooms, supportive teachers, open-ended materials, as well as time, space, and opportunity to explore their environments through play, they will eagerly and enthusiastically develop dispositions for learning that will remain with them throughout their school years and beyond.

1. The Science of Early Child Development (scienceofecd.com), access date 2023-11-23.

Teachers who support these dispositions are ones who hold an image of children as being curious and capable and who understand that learning in the early years is not focused on an accumulation of knowledge but an exchange of thoughts, ideas, and hypotheses that place the teacher in the co-learner role with children and with colleagues–a role where they learn to extend and expand on children's play through careful observation, reflection, and planning.

"Play-based early childhood education programs have been identified as the most conducive to achieving high-quality outcomes for children in the early years."

Ring, O'Sullivan, & Ryan, 2019.

The quote above, which was written within the specific context of lab schools designed for children aged 3-5 years old, supports the main rationale and purpose underlying each of the learning modules developed for this project. The authors of the quote continue by saying *"However research continues to highlight the 'schoolification' of the young children's earliest experiences, whereby child-led curricula and playful pedagogy are replaced by a focus on pre-academic skills, direct instruction, and standardized testing. Linked to the accountability agenda, this intensification of children's early years experiences is leading to an emerging global quality crisis in early childhood education that, unless disrupted, has the potential to negatively impact children's learning and development."* (p. 12)

STREAM-focused lab schools associated with teacher-training institutions serve as places where a playful pedagogy can be modeled, discussed, and researched. They are environments where pre-service and in-service professional learning for teachers of young students can occur, and where best practices are modeled. STREAM lab schoolteachers should be trained in how to support science, technology, reading, engineering, arts, and mathematics in the early years through the design and implementation of developmentally appropriate programming. Additionally, they should also have the skills and experience in mentoring and coaching student teachers.

STREAM lab schoolteachers understand the tension and effort involved in shifting pedagogical practice from a predominantly teacher-directed model to one where children's emerging interests and inquiry help to shape the programming and environment. They

can discuss and articulate how an overemphasis on direct instruction of young children, based on predetermined academic outcomes (e.g., an emphasis on teaching the alphabet, numbers, days of the week, colors, etc., using worksheets and other types of teacher-directed activities), has not been proven to be an effective teaching or learning approach during the early years, especially when supporting foundational skills associated with STREAM (Christenson & James, 2020).

Finally, a STREAM lab school and the teachers who work there can demonstrate how adopting a more play-focused setting, including a well-designed outdoor play area, will provide a more developmentally appropriate environment to support STREAM in the early years.

2.1. How Play Helps to Support STREAM

Science

Play helps children become scientists by allowing them to construct their own knowledge, leading to a better understanding of the world around them. Through play, they can classify objects, make predictions, and use their imaginations.

"During the early years, science is something that children DO, not something that children KNOW"

(Lange et al. 2019, p. 33).

Technology

Play provides children with the opportunity to explore simple tools such as wheels, wedges, ramps, and levers (e.g., seesaws), as well as more complex tools such as scissors, pulleys, and wheeled toys.

"...the T stands for technology but it is not necessarily about computers or other sophisticated machinery. What is important is the item's ability to help solve a problem."

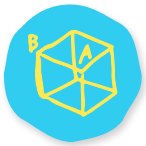
(Christensen & James, 2020, p.10)

Reading/Literacy

Play provides many opportunities for listening, talking, questioning, exploring, predicting, hypothesizing, and discussion. During the early years, it is also a time when children experience books, writing, and story sharing. These activities make literacy meaningful and functional for children. This approach is much more effective than learning through memorization.

"Literacy is the ability to use language in all its forms of communication: listening, talking, reading, writing, music, dance, storytelling, visual arts, drama, and digital literacy."

(Red River College/SECD).



Engineering

Engineers design and build structures, paying attention to how things work or don't work, and they figure out solutions to their problems. Children exhibit similar behaviors when provided with the time, space, materials, and opportunities to play.

"When you dump those blocks on the floor and the kids have to figure out how to rotate and balance, they're physicists. They're having fun, and they're learning the foundation to early skills that we know are related to math (and engineering) skills."

(Hirsh-Pasek quoted in Lange et al. 2019, p.71)

Art

Art and creativity are foundational to all the STREAM components. Creative art entails that children are engaged in the process of creating and are less concerned with the end product; they enjoy the act of 'doing'. In this type of process-focused art, children are not provided with a sample to follow, and there is no 'right' or 'wrong' way to proceed. This approach allows children's art to be unique and original to them, supporting their creativity, exploration, and initiative.

"Art is one of the early symbol systems of young children. It is also an important tool for learning about the world, expressing their ideas and feelings, communicating with their friends and families, and exploring their own creative ideas."

(Moomaw & Hieronymus, 1999)

Math:

Mathematical concepts that children explore during the early years include number relations (quantity and quality), measurements, addition, subtraction, geometry, and patterns. They engage with these concepts while playing with blocks and other construction toys, as well as when collecting pebbles, seashells, buttons, and other items. Additionally, they discover patterns in their environment and in their artistic creations.

"Play provides an optimal environment for supporting math acquisition."

(Sluss, 2019).

2.2. What Is Meant by Play-Based Learning?

Intentional play-based learning enables children to investigate, ask questions, solve problems, and engage in critical thinking.

(Council of Ministers of Education Canada, 2012).

Before delving into play-based learning, it's essential to establish a clear definition of play. Dr. Peter Gray has extensively studied and defined play, highlighting specific characteristics. According to Gray, play is characterized by being self-chosen and self-directed; it is intrinsically motivated, meaning it is pursued for its own sake rather than as a means to an end; it is guided by mental rules, allowing for creativity; and it is imaginative (Gray, 2017). Additionally, Gray identifies various types of play, including physical/locomotor play, constructive play, language play, fantasy or pretend play, social play, and games with formal rules (Gray, 2017).

Mildred Parten, in her seminal work observing children's play several decades ago, described a theory of children's stages of social play. These stages include solitary play, onlooker

"Play, by definition, is voluntary, which means that players are always free to quit. All players know that, and so they know that to keep the game going, they must keep the other players happy. The power to quit is what makes the play the most democratic of all activities. When players disagree about how to play, they must negotiate their differences and arrive at compromises. .... this fundamental skill – being able to negotiate, compromise and see the world from other's point of view is critical if children are to grow up to have happy marriages, good friends, or co-operative work partners."

Peter Gray, 2014.

play, parallel play, associative play, and cooperative play (Parten, 1932). Although scholars, for the most part, no longer consider Parten's stages as linear, they do agree that her description of the various types of social play contributes to our understanding of what play looks like. Understanding that play looks different from day to day and from child to child allows teachers to recognize the value in various play-related behaviors, ranging from children simply observing and exploring their physical and social environment to more complex cooperative play where children organize their play based on common goals, interests, ideas, rules, and themes.

Play-based learning describes how and what children learn through play and requires that teachers are intentional in their practice. This means that teacher's selection of materials and activities and the design of their space are deliberate, purposeful, and thoughtful (NS Government, Capable, Confident & Curious, p. 39). To support play-based learning, teachers must be able to ask authentic questions to children—questions to which they do not already know the answer—to expand their thinking and extend their play. They need to know when to step in and when to allow the children to make discoveries for themselves, even if it takes several tries, and even when the children's theories about what they discover do not match the teacher's theories. Teachers who support play-based learning understand that the goal is not to get the right answer but rather to investigate, ask questions, and engage in critical thinking (CMEC, 2012). Active play supports children's brain development. It is through their play that children learn to:

- Question.
- Explore.
- Discover.
- Hypothesize.
- Wonder.
- Construct.
- Problem solving.
- Innovate.
- Create.
- Concentrate.
- Collaborate.
- Cooperate.
- Communicate.

BOX 1. Creating a STREAM Lab School in Barbados

Beginning in 2020, the Ministry of Technology, Education, and Vocational Training (MTEVT) in Barbados, with the support of IDB, embarked on a mission to convert an existing nursery school into a STREAM Lab School to help support teachers on their journey to support STREAM through play-based learning. Their mission statement was that:

The lab school will be an ideal environment for teaching and learning in which:

- Educators and children use contemporary learning resources.
- Pedagogy is informed by current research.
- The individuality of children is recognized.
- Children and educators' creativity and innovation are fostered.

From the inception of this lab school, the stated objectives were to:

1. Investigate contemporary pedagogical practices within early childhood STREAM subjects.
2. Implement contemporary pedagogical approaches within the early childhood LAB school.
3. Train in-service and preservice early childhood educators in the use of contemporary STREAM practices.
4. Provide a strong foundation for the development of critical thinking, communication, collaboration, and creative skill across STREAM subjects within early childhood settings.
5. Utilize research findings to inform pedagogical practices and policies at the early childhood level.
6. Equip families with knowledge that will foster learning at home.
7. Create an environment that invites families to participate in the LAB school community.
8. Create a community of practice to support and sustain the LAB school initiative.

As with any undertaking, several challenges were identified related to the development of a lab school. These challenges included:

- Adequately trained human resources.
- Adequate contemporary material resources.
- The need to shift teachers' mindset from private classroom practice to a professional collaborative classroom practice.
- The need to support change and innovation through change management training for all partners in the project.
- Critically examine how educators view and interact with children.
- Improve educators' understanding of developmentally appropriate practices.
- Improve differentiation strategies within the classroom.
- Empower educators with strategies on how to change pedagogies.
- Move educators away from a stance of right and wrong to listening to and engaging with children's thinking, approximations, and initiatives.
- Strengthen educators' understanding of how to use manipulatives in the classroom.
- Cultivation of trust, equity, and flexibility among the stakeholders within the LAB school management structure.

To understand and address these challenges, the STREAM Lab School partnership organized professional development sessions for nursery schoolteachers working in twelve different nursery schools in Barbados. Although only one of these nursery schools was designated to become the STREAM lab school, the rationale to include nursery schoolteachers from other schools was to create a training cohort who could learn new skills and knowledge about supporting STREAM through play-based learning.

These professional learning sessions occurred over 18 months and included both in-person and online training events. The training participant cohort also stayed in touch during this period using WhatsApp and email, where they would share questions, ideas, and photos and videos of their efforts to support STREAM through play-based learning.

The course has taught me to reflect and to question how and why I do certain things. It has also provided me with some support for when I want to introduce new ideas that may not be the norm. Lastly, the reminder of how important play is to this age group, yes structure is good but so much can be accomplished when we allow children to choose and be comfortable in their environment. Let them be their age because they will never be this age again".

Training participant, May 2022.

"My major take away from the training was that we, as teachers, are the facilitators of the exploratory process that children are discovering, and we need to accommodate their learning through the design of our classes. We need to assure that are environments are filled with materials which meet their interests so that learning is fun..."

Training participant, September 2022.

"The most important thing I learned was that play is very important. We got to witness firsthand how children can use play to be creative and innovative. I'm still a little uncertain how it would work in our classrooms given that many schools have traditional classroom set-ups and traditional teaching resources, for example, required textbooks on the book list.... I truly enjoyed the sessions and will try my best to include and integrate elements of play-based learning".

Training participant, September 2022

"I strongly believe play-based learning would be beneficial in Barbados. However, all nursery schools should be on board, as well as reception classes. Implementing play-based learning along with parts of our curriculum will, in my opinion, assist students in becoming well-rounded, well-adjusted, socially, and emotionally healthy individuals who have a love for learning and discovery.

Training participant, September 2022.

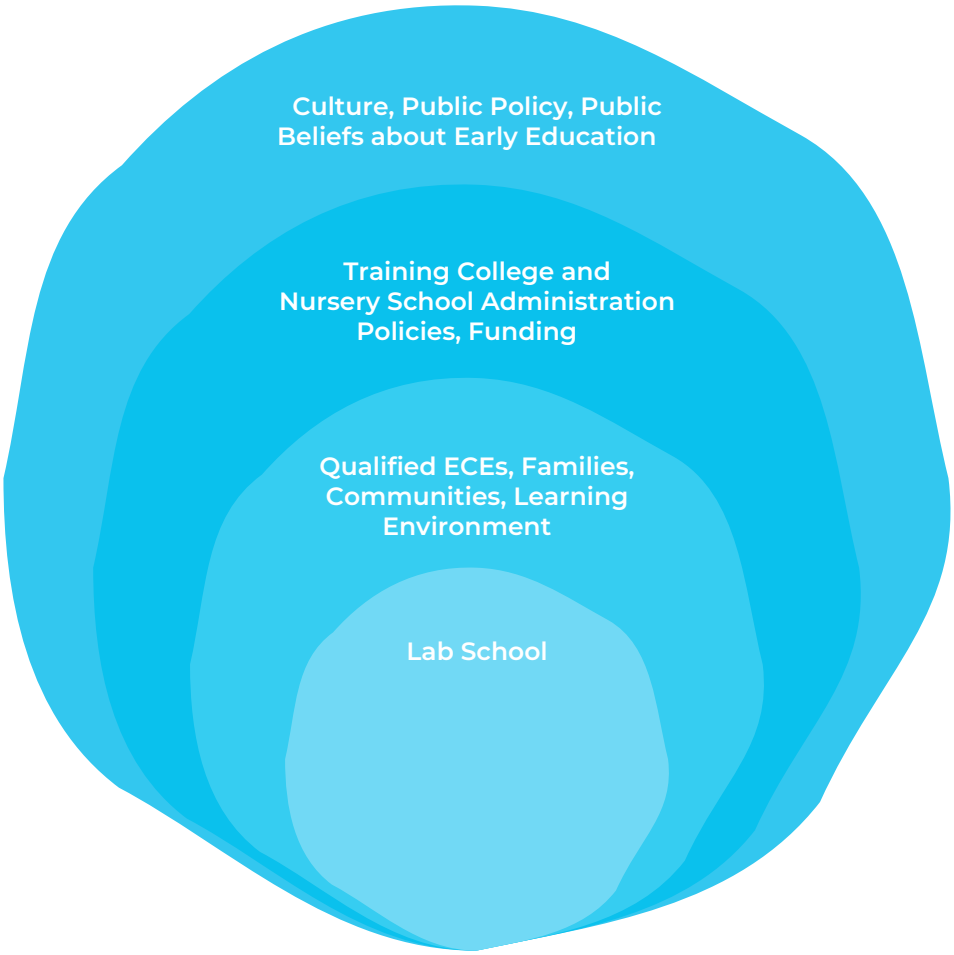
2.3. Pedagogical Change

Moving from a traditional teacher-directed program to a pedagogy of play is a significant shift that often requires a redesign of the learning environment and a daily schedule that provides time for children to play freely. To support this shift in practice, educators must engage in program planning that is responsive to children's ideas, and they must make intentional and deliberate decisions about activities and selection of play materials based on child observation and conversation. A pedagogical shift such as this requires dedicated time for teachers to continue engaging in professional development related to STREAM and play-based learning. Teachers also need opportunities to observe, discuss, and reflect on their 'small steps' and 'bigger steps' as they shift their practice to STREAM and play-based learning.

2.4. Proposed Management Structure

To function effectively, a lab school must be attuned to and aware of the ecosystem in which it operates (Kostelnik, 2017). Factors such as public beliefs about education during the early years, administrative policies, available funding, availability of qualified educators, and the design of the learning environment all play a role in the success of a laboratory school (See Figure 1). Successful lab schools do not operate in isolation; they require the continued support and oversight of an effective management structure consisting of direct stakeholders committed to a collaborative relationship designed to ensure success.

FIGURE 1. Ecosystem of STREAM Lab School



Source: Authors' elaboration adapted from Kostelnik, 2017.

2.5. Recommended Learning Materials for a STREAM-Focused Lab School

The physical environment of a STREAM-focused lab school should encompass both indoor and outdoor play spaces/classrooms, featuring play materials that captivate children's interest. A daily schedule should afford ample time for free-choice, child-initiated activities. Some recommended materials for these play-based environments include:

BOX 2. The Value of Outdoor Play

Connecting with nature daily provides young students with innumerable learning opportunities. Playing outdoors supports children's health and well-being as they experience the benefits of fresh air and exercise. It fosters a connection with the natural environment, promoting appreciation, stewardship, and responsibility for their communities and the world around them. When playing in natural environments, children have opportunities to learn about science as they explore and investigate all that the outdoors has to offer. Additionally, outdoor play encourages imagination, creativity, and the development of social-emotional skills such as turn-taking, conflict resolution, safe risk-taking, and self-regulation. Many adults fondly recall their childhood play experiences, often highlighting the time spent outdoors. In today's increasingly technology-driven world, coupled with the time constraints of busy families, providing young students with natural outdoor play is more important than ever.

Wooden Unit Blocks

Wooden unit blocks are indeed a staple material for every classroom, especially one aiming to support STREAM. They promote all areas related to STREAM and provide foundational knowledge necessary for mathematics (geometry, physics, spatial relations, number, quantity, sequencing, patterning) and engineering (design, problem-solving, creativity). Additionally, they encourage conversation and dramatic play, which are essential in supporting children's literacy and communication skills, and they provide opportunities for collaborative and cooperative play.

To meet all these objectives, each classroom must have a well-equipped block area, with blocks stored and organized by size and shape on low wooden shelves that are accessible to children. Since children will be using the blocks on the floor, an area rug or low-pile carpet piece helps absorb the sound of falling block towers. An area rug also defines a space for the block area, which can generally accommodate 3-4 children at a time. Block play should be one of the activities available to children during free-choice time in a play-based program.

Books related to Science, Technology, Engineering, and Math

There are numerous books that encourage, support, and inspire children's exploration of science, technology, engineering, and mathematics as well as promote creativity and language/vocabulary development. See Appendix 1 for list of titles. Some of the books on the list are recent releases, while others are timeless classics like "The Very Hungry Caterpillar" by Eric Carle. This compilation serves as a starting point, acknowledging that there are numerous other books that could be added to enrich children's reading experiences. Additionally, apart from books related to STREAM, it's crucial that classrooms include high-quality children's literature covering various topics, themes, and genres. Appendix 1 also includes links to such high-quality children's literature. Before purchasing any book, it's recommended to preview it online to ensure cultural suitability. This ensures that the literature chosen reflects the diversity of the classroom and respects the cultural backgrounds of all students.

Literacy Materials

To promote reading and literacy behaviors, children must witness and experience the functionality and pleasure of reading, writing, talking, and listening. Therefore, in addition to a well-stocked classroom library, children must be provided with an assortment of writing materials such as blank paper of different sizes and types, markers, crayons, pencils, clipboards (a set of 8 per classroom) which can be used as portable writing surfaces to encourage writing, sketching, and mark making throughout the learning environment, including the outdoor play area.

Manipulatives

Manipulative materials are items that children can use to explore actively and hands-on. They are sometimes referred to as tabletop toys and can include small wooden blocks, peg boards, geoboards, tangrams, interlocking building blocks, magnet tiles, and other small objects that support mathematical skills such as counting, sorting, classifying, sequencing, patterning, seriation, and estimating. They promote engineering and technology by facilitating designing, predicting, planning, and trial and error. Additionally, they encourage art by supporting creativity and individual expression, and they facilitate science through experimentation, hypothesizing, and testing theories, such as, "I think I can build a very tall tower with these magnet blocks." Tabletop toys can be provided as an activity for smaller groups of children (3-5 children) during free-choice time. More materials can be added as time and budgets permit.

"In trying to implement some play-based activities in the classroom slowly but surely, most mornings before school begins, the students play with toy blocks. One morning a student showed me her blocks, and she had sorted them by colour! ...We will definitely be doing more play-based activities."

Training Participant, May 2022

Loose Parts and Found Materials

Loose parts, a term coined by architect Simon Nicholson in 1971, are defined as anything that can be moved, changed, taken apart, and adapted in multiple ways with no specific instructions. According to Nicholson, the more movable and adaptable materials an environment contains, the more creative and inventive children will be. According to Lisa Daly and Miriam Beloglovsky in their book entitled "Loose Parts: Inspiring Play in Young Children", loose parts bring a new level of creativity and innovation to a classroom environment. In addition of being developmentally inclusive, sustainable, and economically feasible, these authors state that loose parts also:

- Promote active learning.
- Deepen critical thinking.
- Foster divergent and creative thinking.
- Support developmental domains (physical, social-emotional, cognitive).
- Encourage a wide range of plays (functional, constructive, dramatic, symbolic).
- Support the curriculum (math, physical science, dramatic play, language and literacy, art, sensory exploration, music, and movement).

Children will explore and manipulate loose parts in a variety of ways. *"Loose parts can be moved, carried, combined, redesigned, lined up, taken apart, and put back together in multiple ways. Used alone or combined with other materials. There are no set specific directions for materials that are considered loose parts. The child is the direction."* (Penn State Extension) They can be used alone or combined with other materials. While playing with loose parts, children will naturally engage in activities which will demonstrate a variety of learning outcomes such as:

- Constructing sets.
- Identifying the number of objects in a set.
- Creating and extending repeating patterns to two or more repetitions.
- Using direct comparisons to compare two objects based on a single attribute, such as length or height.
- Identifying a common attribute in each set of 3-D objects.
- Sorting a set of objects including familiar 3D objects, using a single attribute such as size or shape, and explaining the sorting rule.
- Building and describing 3-D objects.

"(I learned to) ... enable students to explore their talents more through self-directed activities which can be initiated by me, the teacher, by the materials that I provide. More focus should be given to developing independence. More play does NOT mean less learning or that I am not doing a good job."

Training participant, September 2022.

The educator's role in offering loose parts involves gathering a diverse array of items and subsequently presenting them to children, empowering them to freely explore and utilize these materials in accordance with their own preferences and creativity. It is helpful to include 'layouts,' which can be large pieces of paper or fabric or even empty picture frames, providing children with defined space and boundaries for their loose parts play. Additionally, loose parts should be kept in individual containers, e.g., a container for buttons, a container for seashells, and then provided to children with tools or 'invitations' to explore.

(Photo of children playing with loose parts in Barbados. Photo submitted by a training participant, September 2022)

Loose parts are generally 'found materials,' meaning objects that educators might find around their home. For example, keys that aren't used anymore, button collections, seashells, pebbles and rocks, bottle caps, corks, marker tops, jar lids, fabric scraps, nuts/bolts/washers, and more. Loose parts such as glass pebbles, pom poms, and beads can also be purchased locally at discount stores. However, many types of loose parts do not need to be purchased and can be sourced from parents, teachers, and the larger community. They can be made from manufactured materials, e.g., buttons, or found in nature, e.g., feathers, seed pods, or shells. Because these materials are generally sourced locally, they can be reflective of the community where they will be used.

"I've started my loose parts collection and have been giving the students the opportunity to have a free choice activity in the afternoon after they have had their rest. They've been enjoying it so much and it was a very good opportunity to learn about the new students - the ones who were sociable, the ones who like to lead and make the rules, the ones who prefer to work alone. Some of them went straight into their activities, while others carefully looked on. My next project is to get the water table going!"

Training Participant,
October 4, 2022.

Loose Parts Play during September 2022 Training Session

Arts/Creativity

The focus of art during the early years should be on the process of creating rather than emphasizing the end product. Therefore, educators should avoid pre-designed crafts (modelled art), coloring books, worksheets, and other product-focused materials that require adult direction. The early years are a time for sensory and intellectual exploration of how materials feel, work, change, and react to the child's experimentation. Through this exploration, children learn to express themselves – first by making marks, then by drawing pictures, and eventually through writing/drawing letters and words. For this reason, art materials should be readily available to children during daily free-choice times.

In addition to drawing and painting, children should have access to collage materials (scraps of paper, gift wrap, shapes, bits of fabric, etc.) along with a supply of construction paper and glue. Furthermore, children should be able to create 3-D constructions using wood scraps, paper towel rolls, containers and boxes of various sizes, wire, tape, and their imaginations. Most of these materials are easily accessible, and some nursery schools find it useful to invite parents to bring in materials such as these, where they can have a new life as art materials.

Sensory Materials

All materials are sensory materials to a certain extent; however, some are specifically designed to engage the senses. Examples of sensory materials that can be used indoors and outdoors include homemade playdough, 'slime' or 'ooblick' (made with cornstarch and water), sand play, and water play. Gardening and cooking activities also provide a variety of sensory experiences and meaningful encounters with math, science, and reading/literacy. Playing with these types of sensory materials can occur during free choice time and outdoor play, such as sand play and water play, or can be done as small group experiences, such as cooking activities and making and playing with playdough and 'slime'.

Duschl and colleagues (2007 as quoted in Näslund-Hadley & Bando, 2015) outline the types of inquiry young children are apt to conduct. The four general competencies described to address children's innate curiosity for the material composition of physical objects, how those objects change under certain conditions, as well as why certain reactions occur. Additionally, they explain children's capacity to observe, measure, and categorize an object's physical properties, as well as evaluate methods for conducting such inquiry.

(Näslund-Hadley & Bando, 2015, p. 28)

Materials that support sensory play include sensory tables, which can be used for either sand or water play, as well as cooking utensils (measuring cups, eggbeaters, colanders, etc.), buckets, shovels, scoops, wallpaper smoothing tools, and small wooden or plastic props, such as people, dinosaurs, animals, fish, cars, and trucks.

Tools to Support STREAM

There are many tools and gadgets designed to support children's exploration of their environment, promoting investigation and inquiry related to STREAM. Examples of these tools include scales, balances, magnifying glasses, children's microscopes (handheld digital microscopes), sorting trays, tongs, tweezers, jars, funnels, toy cash registers, measuring tapes, rulers, dice, and spinners. More advanced tools such as coding kits, robotics, and circuit mazes are also available but may not be developmentally appropriate for nursery school and are not necessary for young children who have a good supply of the other materials provided in this list.

It's extra hard to grow and develop our autonomy when we have someone who keeps setting things up for us, telling us what to do and what not to do. We all need space to grow.

Clare Caro, Authentic Learning Environment

3. Moving Forward with Pre-service and In-Service Professional Development and Training

It is recommended that courses specific to play-based programming, STREAM in the early years, and pedagogical documentation be included in post-secondary Bachelor of Education Primary programs. Coursework in these areas can be supplemented and enhanced through practical experiences and observations in a STREAM lab school. Alternatively, an in-service certificate in STREAM could be developed and offered to nursery schoolteachers, reception teachers, and recent graduates of B.Ed. primary programs to strengthen their skills in supporting and facilitating STREAM in nursery school, reception, infants A and B, and beyond.

Ongoing professional development related to play-based programming and STREAM for nursery teachers, especially those associated with lab schools, is essential. This project in Barbados allowed for 40-50 hours of professional development over 16 months. Although the learning and engagement by the training participants were evident, it was also apparent from the comments in their evaluations that this information is very new to them, and many questions remain about how to implement these new ideas in their current practice. Their questions related to topics such as how to facilitate children's discovery and exploration through open-ended questions; how to articulate the

benefits of play-based learning; how to achieve attainment targets (Govt. of Barbados) through play, and more details on the role of the teacher in a play-based classroom.

Finally, nursery schoolteachers must be supported through this process of program change. Many of the topics discussed during the professional development training sessions were new to the participants. They have articulated that they see the benefits of supporting STREAM through play, and several of them are willing to try new ways of teaching. However, they now require coaching and mentoring. As teachers, they are experiencing some disequilibrium in their practice – trying new approaches and not always being successful, which is typical when individuals are moving out of their comfort zones. They could then easily default to their past practices, relying on teacher-driven instruction of pre-academic skills, without the support and advice of a pedagogical leader who can provide ideas, answers, encouragement, and support. For this reason, having mentorship and facilitated communities of practice, where teachers can come together with their questions and ideas to help and inspire each other, will support their success as teachers in a play-based environment. Additionally, it is necessary to provide more tangible support in the form of time for planning, reflection with colleagues, professional development, and access to classroom and professional materials and resources related to STREAM.

4. Parent Education Program

Parents are an essential component of children's educational experience. When parents understand what children are learning and why they are learning it, they can become advocates not only for their own child but also for the broader educational system. Developing a parent education program and engaging with parents, in general, is essential to the overall quality of children's education; however, it can also present challenges. Parents of young children are often very busy, with limited time and resources. Teachers must consider the needs, availability, work schedules, and other family responsibilities of parents when designing a parent engagement program.

As part of the STREAM Lab School project in Barbados, parents expressed a desire to be kept informed about their child's daily activities and showed interest in occasional workshops designed for parents to gain more knowledge about the daily operations of the classroom. They emphasized the importance of the teacher-parent relationship, indicating a desire to be involved and considered in decisions about their children's education.

Supporting STREAM during the early years will require a significant shift in pedagogical practice, moving from a teacher-directed approach to a pedagogy of play and play-based learning. As teachers make this shift, it is imperative to inform parents from the very beginning about how this pedagogical practice supports STREAM and what they can expect from their children. Additionally, parents can be provided with information about how to support their children's learning at home using the same type of play-based learning. For a list of parent resources, see **Appendix 2**.

5. Conclusion

"Children are more capable and competent than we actually think"

(Training participant, September 2022).

The introduction of lab schools focusing on supporting STREAM through play-based learning has the potential to change the educational trajectory of young children, transform the practice of nursery school-teachers and teacher educators, and support innovation and creativity at all levels of education. The key to a successful lab school will be the teachers who demonstrate best practices and the management team that supports them in doing so. The support provided by the management team must include appropriate levels of resources and funding related to staffing, training, program materials, and administration, and this support must be reliable and ongoing. Continued professional development is necessary to support the teachers in their practice and is a commitment to providing the tangible and intangible resources required to operationalize all aspects of the lab school. For more information and resources related to lab schools, see **Appendix 3**.

The path forward will not always be easy but the benefits for children, families, and communities will be well worth the effort.

Through their interactions with the physical world, young children generate questions about how things work. The teacher's responsibility is to use those questions to spur the investigative process and to promote discovery through prediction, experimentation, and reflection.

(Näslund-Hadley & Bando, 2015, P.28)

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Appendix 1 Children's Literature

Children's Books that support STREAM

Book Title	Author	Comments
When I Build with Blocks	Niki Alling (2014)	
Five More Minutes	Marta Altes (2020)	
I Am An Artist	Marta Altes (2022)	
Up, Down, and Around	Katherine Ayers & Nadine Bernard Westcott	
Yellow Ball	Molly Bang (2016)	
A Day at the Beach	Tom Booth (2018)	
Spaghetti and Meatballs for All	Marilyn Burns (2008)	Marilyn Burns is the author of other books that support STREAM
The Very Hungry Cater-pillar	Eric Carle (1981)	A time-honoured classic
The Tiny Seed	Eric Carle (1991)	
If You Find a Rock	Peggy Christian (2000)	
Big Bug	Henry Cole (2014)	

Book Title	Author	Comments
Forky in Craft Buddy Day	Drew Daywalt (2019)	
Leaf Man	Lois Ehlert (2005)	
Bajan Baby What Do you See?	Terri-Ann Hopkin (2020)	Written by a Barbadian author, who is also an ECE. A matching puzzle is also available
Bajan Baby, Count with Me	Terri-Ann Hopkin (2021)	
You are (Not) Small	Anna Kang and Christopher Weyant (2014)	
Be a Maker	Katey Howes (2019)	
The Doorbell Rang	Pat Hutchins (1989)	
Rosie's Walk	Pat Hutchins (1971)	
Stuck	Oliver Jeffers (2011)	
Inch by Inch	Leo Lionni (1960, reprinted in 2018)	A classic book and Caldecott Award winner
Swimmy	Leo Lionni (1963 reprinted in 2017)	
The Little Red Fort	Brenda Maier (2018)	
Which is Round? Which is Bigger?	Mineko Marmada (2013)	
Chicka Chicka Boom Boom	Bill Martin Jr. (1989 reprinted in 2012)	
Panda Bear, Panda Bear, What Do You See?	Bill Martin Jr. (2006)	
Beautiful Hands	Kathryn Otoshi (2015)	

Book Title	Author	Comments
We're Going on a Bear Hunt	Michael Rosen and Helen Oxenbury (2003)	A classic rhyme that encourages children to remember sequencing
Max Found Two Sticks	Brian Pinkney (1997)	
Let's Make Faces	Hanoch Piven (2013)	
Not a Box	Antoinette Portis (2006)	
Not a Stick	Antoinette Portis (2007)	
The Dot	Peter H. Reynolds (2003)	
Fox Walked Alone	Barbara Reid (2009)	
Watch It Grow: Backyard Life Cycles	Barbara Reid (2019)	
Piggies in the Pumpkin Patch	Jennifer Rofe	
Boxitects	Kim Smith (2019)	
The Most Magnificent Thing	Ashley Spires (2014)	
Made by Maxine	Ruth Spiro (2018)	
Count on Me	Miguel Tanco (2019)	
Press Here	Herve Tullet (2019)	Board Book
Mix it Up!	Herve Tullet (2021)	Board Book
How to find a bird	Jennifer Ward (2020)	
The Napping House	Audrey Wood (1991)	
Be Kind	Pat Zietlow Miller (2018)	

High-quality Children's Literature

In addition to books that support STREAM in the early years, it is important for lab school classrooms to showcase high quality children's literature in general. Here are some useful links to lists of book titles and descriptions.

- National Public Radio
  https://www.npr.org/2020/08/31/905804301/welcome-to-story-hour-100-favorite-books-for-young-readers
- Time Magazine 100 best children's books
  https://time.com/100-best-childrens-books/
- Books for Topics Preschool: 50 Recommended Reads
  https://www.booksfortopics.com/booklists/recommended-reads/preschool-nursery/
- Scholastic: Teacher Picks: Top 25 Picture Books
  https://www.scholastic.com/teachers/teaching-tools/book-lists/teacher-picks--top-25-picture-books.html

Appendix 2 Online Resources for Parents

Videos:

- Brain Matters Documentary
  https://www.youtube.com/watch?v=Rw_aVnlp0JY
- Play-based learning with Peter Gray
  https://www.youtube.com/watch?v=wJaAegok8L4
- Integrating Technology into a Preschool Classroom
  https://www.youtube.com/watch?v=uYoCfBA9Xpc
- Early Exploration of Attributes with an Avocado (Erikson Institute)
  https://www.youtube.com/watch?v=BDiWe0_Hj4I
- Just right for me: Estimating Measurement in Preschool
  https://www.youtube.com/watch?v=pqnqE7p5KSE

Information Sheets:

- What children learn through play
  https://www.child-encyclopedia.com/play
- Help your child develop early math skills
  https://www.zerotothree.org/resource/help-your-child-develop-early-math-skills/

Websites/blog posts:

- Zero to Three (Harvard University)
  https://www.zerotothree.org/resources/for-families/

- The Power of Play: 6 Benefits for Child Development
  https://www.epl.ca/blogs/post/importance-of-play-for-kids/

Resources to share with children:

Videos:

- Simple and Complex Machines
  https://www.youtube.com/watch?v=8GHRZabpsQE

- The Alphabet Hip Hop
  https://www.youtubekids.com/watch?v=1rVl2oM6ACE&hl=en-GB

- The Counting Song
  https://www.youtubekids.com/watch?v=OXGaGttahxY&hl=en-GB

- DO NOT OPEN THIS BOOK AGAIN by Andy Lee & Illustrated by Heath McKenzie
  https://www.youtube.com/watch?v=N8XDGi0rPmw

- Monster Counting Book 1 to 20 by Frances MacKay
  https://www.youtube.com/watch?v=qWxKEguWric

- Noise Animal ABC by Frances MacKay
  https://www.youtube.com/watch?v=SkS_Du9j8wk

Appendix 3 Laboratory Schools Readings and Resources

Brenneman, K., Lange, A., & Nayfeld, I. (2019). Integrating STEM into Preschool Education; Designing a Professional Development Model in Diverse Settings. *Early Childhood Education Journal* 47: 15-28.

Caribbean Early Childhood Development Good Practice Guide (UNICEF)
https://issuu.com/caribank/docs/ecd_gpg_2017-final-02-18_web

Caribbean Child Development Centre at University of the West Indies
https://www.open.uwi.edu/ccdc

International Association for Laboratory Schools (IALS)
https://www.ialslaboratoryschools.org/

IALS Journal
https://www.ialslaboratoryschools.org/resources

Kostelnik, M. (2017). What child development laboratories need to thrive: An administrator's perspective. In N.E. Barbour & B.A. McBride (Eds.), *The future of child development* lab schools: Applied developmental science in action (95-112). Routledge.

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