CURRICULUM TITLE:

TRADITIONAL STORIES IN EARLY CHILDHOOD EDUCATION

Teaching Stories through Robotics & Programming

A Curricular Unit for Preschoolers – 4 to 7 years old

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For my curriculum unit I chose "The Traditional Children's Stories, for the integration of programming and robotics" as my curricular theme and "powerful ideas". This theme can be worked on, with the same lessons, using several traditional stories for children. In this case I chose the story of the "3 Little Pigs". My great general learning objective is that children learn to program the KIBO robot, through the retelling of this story. This curriculum unit is linked to other subjects outside the STEM, because it starts with children's literature and goes through the conception of the global project, that is, the construction of 3D scenarios using the work of artistic, plastic and musical expression, associated to the story I chose.
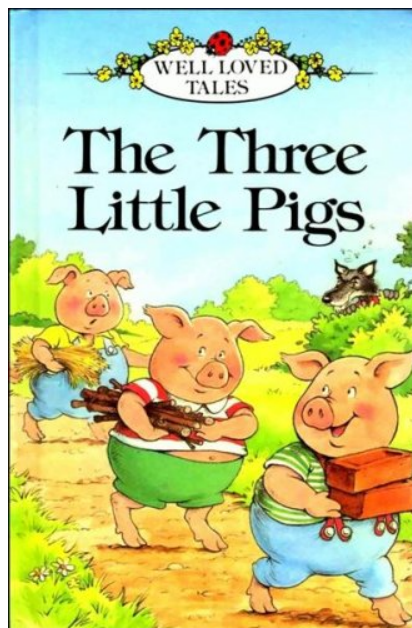

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Papert (2000) tell us "that powerful idea afford new ways of thinking, new ways of putting knowledge to use, and new ways of making personal and epistemological connections with other domains of knowledge" (cit in Marina Umashi Bers, 2018, p. 70). The inspiration for the work developed by Professor Marina Bers and her research team was fundamental to the implementation of this curriculum. For the development of this work it was important to understand that "as a designer of playground experiences for coding I need to understand the development characteristics of young children and the context in which they are likely to engage with programming" (Marina Umashi Bers, 2018, p. 163).

In this curriculum my intention was to meet the interests and motivation of preschool children (4 to 7 years old) and to seek the development of other curricular areas in a transversal way. According to Marina Umashi Bers (2018) "the way we design can engage, encourage, and promote certain experiences while hindering others. For

example, while programming with KIBO allows the use of materials such as recyclables and arts and crafts" p. 164. Learning to program with the KIBO Robot is an opportunity that children have to understand the technologies and learn from them, for the development of a project of their interest. According to (Marina U. Bers, 2010) "robotics presents an opportunity to introduce children to the world of technology and engineering. Robotic manipulatives invite children into activities that develop fine motor skills and hand-eye coordination and into activities that involve collaboration and teamwork" (p. 2).

This proposal fits into the constructionist paradigm of Papert (1999), also integrating Piaget's constructivism, regarding what we know of the child and as Papert refers to the KIBO as technology "(...) gives children greater autonomy in exploring larger worlds, the ideas he pioneered become more urgently relevant to parents and educators" (p. 1). A constructionist learning environment allows the child to enter a creative process that involves them in learning and challenges them at various levels.

This project with the KIBO robot will allow the child to play a crucial role in the activity and think about a project with a multilevel dimension. The intention is to develop a curriculum of interest to all children and promote the sharing of ideas and negotiation of interests for a common goal, while developing other skills associated with Powerful Idea and early childhood education. According to Marina Umashi Bers (2018) you can see "how each of powerful ideas presented here are related to common topics taught in early childhood education" (p. 77). The children will have the opportunity to retell the story of the 3 little pigs and develop several activities that help to consolidate the essence of the story. I believe that programming the KIBO Robot to tell a story will meet the interests of pre-school age children because, "Children love to tell stories; they talk about what happened over the weekend, about family events, and about different happenings in the classroom. Each of these stories can be broken down into a sequence of activities. Teachers can ask targeted questions to help children extend these ideas. For example, a teacher might ask, "What happened last?" "What happened first?" and "What happened in the middle?"" (CSTA, 2016, p. 194).

For the development of the project it was fundamental to know in depth the curriculum of KIBO. To Marina Umashi Bers (2018) "each curriculum unit consist of a minimum of 20 hours and is designed to take place over the course of one intensive week of work (i.e., in a camp setting or during a coding or robotics week at school), or over the course of a few month with one or two sessions per week" (p. 81). The curriculum I developed was inspired by the lessons from "Sample KIBO robotics curriculum structure" (Marina Umashi Bers, 2018, p.82):

Table 6.2 Sample KIBO robotics curriculum structure

Lesson topic	Children will be able to . . .
1- Engineering Design Process	• Build a sturdy, non-robotic vehicle • Use the engineering design process to facilitate the creation of their vehicle
2- Robotics	• Describe the components of a KIBO robot • Scan a program onto the KIBO robot using the wooden blocks • Build sturdy robots that move
3- Programming	• Point out or select the appropriate block corresponding to a planned robot action • Connect a series of blocks by fitting the pegs of one block into the hole of the following block • Scan a completed program onto the KIBO robot • Fix the sequence if they see it doesn't work (debugging)
4- Sensors (part 1)	• Use a sound sensor with KIBO • Program with the Wait For Clap Block • Compare and contrast human sense and robot sensors
5- Repeat Loops	• Recognize a situation that requires a looped program • Make a program that loops • Use number parameters to modify the number of times a loop runs
6- Sensors (part 2)	• Use a distance and light sensor with KIBO • Compare and contrast human senses and robot sensors
7- Conditionals	• Connect a light sensor to the robot • Identify a situation that needs a branched program • Make a program that uses a branch
8- Final Project	Children build and program a robot of their own design. The final project can integrate with a variety of themes including. Sample final project curricula include: • *Dances from Around the World* (robotics + music) • *Patterns All Around Us* (robotics + math) • *The Iditarod* (robotics + social studies) • *How Things Move* (robotics + physics)

I used the "Sample KIBO robotics curriculum structure" (Bers, 2018, p.82) and briefly my curricular unit will allow to develop:

Lesson Topic	Children will be able to…
1- The Enginee-ring Design Process	• Plan a project from a traditional story, through group work, promoting collaboration among children • Idealize how to put the previously built scenery in 3D and the paths, for the robot to follow • Designing robot prototypes for the realization of the project

	• Using "The Engineering Design Process" will allow the group of children to conceptualize the various phases to build their robot (engines and sensors needed for each of the lessons) and decorate KIBO as the main character, the "Bad Wolf"
2- Robotics	• Define the character that will later be programmed to retell the story with the Robot • Know What Is A Robot? • Know and be able to identify all parts of the KIBO Robot • Try to assemble the KIBO robot and realize how it works (place motors, wheels, turn on, scan the blocks), so that the robot moves • Program the robot in several steps, with the simplest programming blocks (front, back, right and left), allowing the child to see how the robot moves and executes a sequence of actions
3- Progra- mming	• Define routes that the robot will have to take to get to the house of each one of the little pigs • Program the robot with a complete sequence (go through all the houses) • Understand what errors they encounter in programming, but also how they can simplify the algorithm and thus work on debugging
4- Sensors	• Use the "Sound" sensor and the "Wait For A Clap" block at the beginning of the programming sequence • Use the "Light Output" actuator every time the Robot ("Bad Wolf") passes in front of a House. The Child realizes that the KIBO robot has completed one stage of the programming.
5 - Repeat Loops	• Use the "Repeat Loops" blocks in programming situations that need to be simplified, for example, in the sequences where the "Bad Wolf" goes to each one of the houses • Understand the advantages of using the loop blocks and a number of repetitions, so that the Robot ("Bad Wolf") is able to go from the Forest and go to each one of the "3 Little Pigs" houses.
6 – Conditio- nals	• Use the "Light" actuator after completing the sequence, as a way to perceive the end of the whole journey through the forest and passing through the houses of the "3 Little Pigs" • Realize that when the robot arrives at a house, it needs to identify this situation as a condition to be evaluated by the robot. For example, the robot when finding the first house turns around and continues the route. Here you can use the "If" and also the "Distance Sensor".
7- Final Project	• In the final project the child will be able to retell the story of the "3 Little Pigs", with the KIBO robot as the main character, the "Bad Wolf" • To expand the Project, the Child can integrate one or three more robots, which would play the role of the "3 Little Pigs" and they would have to have a program to escape from the "Bad Wolf" • Children can also explore the dance choreography, presented in the musical video

| | • Use the Robot ("Bad Wolf") as a character of other traditional stories, that the children know and here work the curriculum unit. |

The curriculum development can take approximately 20 hours, during 3 weeks. It includes 6 structured activities that have a duration of 60-120 minutes and a final project. Before the implementation of the KIBO curriculum unit I will start with reading the story of the "3 Little Pigs" and watching a musical video of this story. Then the children will build the 3D scenarios of the story (the Forest and the Straw, Wood and Brick houses), with recyclable materials.

The development of this curriculum is in line with the idea presented by Sullivan (2019) in relation to the STEM concept, because "we know that multiple aspects of STEM can often be explored together, especially at the early childhood level. Children can explore counting and numeracy while creating a computer program. They can employ the scientific method while exploring engineering. The possibilities for authentic overlap are endless (p.15). I realize that this curriculum is interconnected because "The proposed K–12 Computer Science Framework is itself an amalgamation of such principles and draws on Papert's (1980) "powerful ideas" to articulate specific computer science concepts and practices for the K–12 learning environment. (…) These pre-K computer science concepts and practices build foundational knowledge and understanding for later engagement in computer science at the elementary school level" (CSTA, 2016, p. 184)

It is important to remember that each lesson has specific goals that may not be adjusted to all ages in kindergarten. My proposal is general for children attending kindergarten, but all lessons should be adjusted to the age and development of the child. Reaching lesson 6 and introducing the conditional "Ifs" may not be for all children between 4 and 7 years of age and this lesson should be adjusted to the skills the children have already acquired and previous experience, the ideal being to work on these concepts with children over 6-7 years of age.

Materials

For the work that will be developed we need preferably one KIBO Robot KIT for every 4 children, this being the ideal situation. However, if this possibility does not exist the organization and management of the KIBO robot should be the responsibility of the Educator.

Besides the KIBO Robot it is important to provide several working materials that are mentioned in each of the lessons. They can always add other materials, even if they are not in the lessons, but that they consider useful for the realization of the activity or also materials that the children bring from their own home to work on the project. It is important that the materials allow the child to build projects based on their ideas and that access to these materials is not limited.

Student Assessments

Regarding the implementation of the project in preschool it is important to realize that the whole process of teaching - learning must promote the presence of the 6 C's (Creation Digital Content to Promote Competence, Creativity to Build Confidence, Choice of Conduct to Develop Character Traits, Communication for Promoting Connections, Collaboration Form Caring Network, Community Building as Contribution) and realize that they are all interconnected. The adult throughout the implementation of the KIBO curriculum takes a position of work guidance, allowing the child to explore his or her own ideas through the challenges that are posed.

As this work is designed for children attending kindergarten, it is undoubtedly a privileged education context to promote all the behaviors of the PTD Framework (Marina Umaschi Bers, 2012, p.13), taking into account that this is inspired by Constructionism, developed by Seymour Papert and Positive Youth Development, because it puts the child in the central place of the learning process.

Using the PTD Framework will allow the Educator to understand how the curriculum is being implemented and to adjust new ways of working with children in a timely manner. The intention is to allow all children to fully experience all the lessons and consolidate the knowledge that is intended to develop in a playful and involved way.

Powerful Ideas in the KIBO Curriculum: Traditional Stories in Early Childhood Education

All the lessons take place around the great "Powerful Idea", which is to tell the story of the 3 little pigs. I present the lessons I developed for my curriculum, but it is important not to forget that, "Educators who want to introduce coding in the early childhood classroom need (...) programming languages, but they also need a curriculum of the powerful ideas of computer science that is developmentally appropriate and a guiding framework that understand the whole child" (Marina Umashi Bers, 2018, p. 180).

I present the first step towards the development of other themes, which are of interest to children, from traditional stories. The child is also invited to explore programming and robotics in themes that are happening in their family or educational context. The intention is always to take advantage of our children's "Powerful Ideas" and that they make sense for their learning process.

Powerful Idea: **Traditional stories for children and the Choice of the story the 3 Little Pigs - Robotics with the KIBO Robot**

OVERVIEW:

In lesson 1, the Educator knows that students are interested in the theme of traditional stories and every day they like to hear a story. In these ages (4 to 6 years old), the 3 Little Pigs' Story is always one of the favorites, because they have to deal with the "Fear" they have of Wolf and manage to put themselves in the role of the 3 Little Pigs that always manage to get out of every situation well.

The children in this curriculum have the opportunity to experience the whole process of engineering design, to explore how to build and organize the elements of the scenario, and to program the KIBO.

In this process children can imagine and define which or which paths "Wolf", who will be the main character of Robot KIBO, will take. It is possible that children need to test the sequence of actions with their own body and thus experience the notions of space and sequence, through what I consider to be important, that is, the computational thinking without technologies.

Knowledge & Objectives

Prior Knowledge:

- Students have previous experience in making projects based on traditional stories, which promote the knowledge of different curricular areas and the use of different materials.
- Students will have previous experience in the area of computational thinking without technologies and that involves the programming concepts that are expected for these ages

Students Will Understand That:

- The *engineering design process* is useful for planning and guiding the creation of artifacts.
- There are many different kinds of engineers
- The creation of a project integrates several parts and different work teams, to achieve a common goal

Students Will Be Able To:

- Plan a project from a traditional story, through group work, promoting collaboration among children
- Idealize how to put the previously built scenery in 3D and the paths, for the robot to follow
- Designing robot prototypes for the realization of the project
- Using "The Engineering Design Process" will allow the group of children to conceptualize the various phases to build their robot (engines and sensors needed for each of the lessons) and decorate KIBO as the main character, the "Bad Wolf"

Materials Needed:

- Story Book "The 3 Little Pigs"
- Musical Video "The 3 Little Pigs": https://www.youtube.com/watch?v=KL5-wzi1Mpw
- Engineering Design Process poster
- Pictures of different parts of the story
- White sheets, pencils and colored pencils
- Parts of the 3D Scenario of the History of the 3 Little Pigs to be set up in the kindergarten room

Activity Description:

Warm-Up Activity (Time: 30 minutes)
The Educator tells the story of the "3 Little Pigs" and then visualizes the Musical Film of the story, to involve the children in a Multimedia dimension and encourage the next work. This warm-up time serves as Motivation and Engagement and will provide children with the necessary basis to develop their own powerful ideas.

Main Activity (Time: 60 minutes)
Introduce the concepts and the task to be developed, following the inspiration of the Engineering Design Process. In large group talk about the story and the film. Show the different parts of the story scenarios and promote discussion about each character and their role in the story. Question the children how we will create the scenario of the story in our room to tell the story? We share ideas and introduce the stages of the engineering design process.
We divided the children into 4 working groups. Each group identifies the concepts associated with the part of the story they have to develop. The children draw the elements to be built or reused available in the room, thus creating a conceptual map of the story and promoting the development of Powerful Ideas. The Children build with recyclable materials or reuse objects, for each part of the story.
Example of dialogue with the Children:

"In Lesson Number 1 we will learn how to develop our Powerful Idea, with the help of engineering design process. So, it's important to realize that when you do a project is because you have questions you would like to answer. You will be able to imagine how to answer those questions. You will be able to plan solutions! You will be able to create your solutions, test and improvise your creations. If in the end you feel that new questions have come up, don't forget that it's important to go through all the phases of the engineering design process again."

Concluding Activity (Time: 30 minutes)

Share the results of Main Activity with the large group

and experimenting with the placement of the various scenarios in the room. Children play freely to experience how the characters move in the story, thus promoting the retelling of the story without technologies and with the possibility of experiencing the sequential movements with their own body.

Lesson 1 Vocabulary

- *Design* - a plan for a building or invention. Children experience the role of managers of a great project
- *Engineer* - someone who invents or improves things. Children build and experiment with what they develop
- *Story's* - Traditional stories and their narrative, which allow the development of language, imagination and creativity
- *Story Characters* - Identification of characters and their characteristics
- *Action/Sequence* - Children are able to describe the actions and sequences of each of the characters

Assessments To Be Used:

- Photos and Video
- Designs
- PTD new Engagement Checklist new Children (one for each age)

Activity Results (Photos and Video):
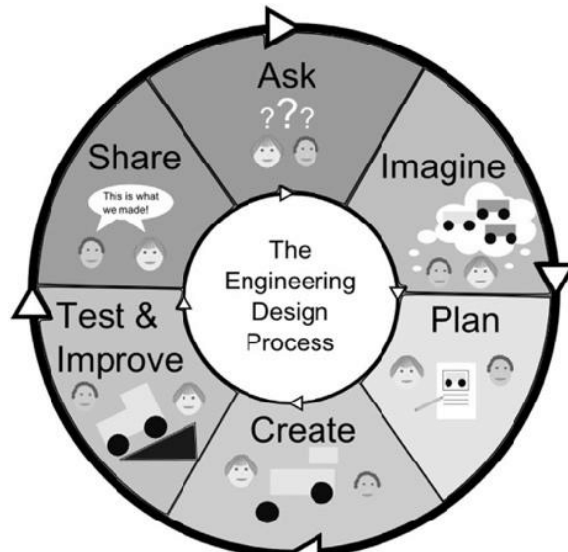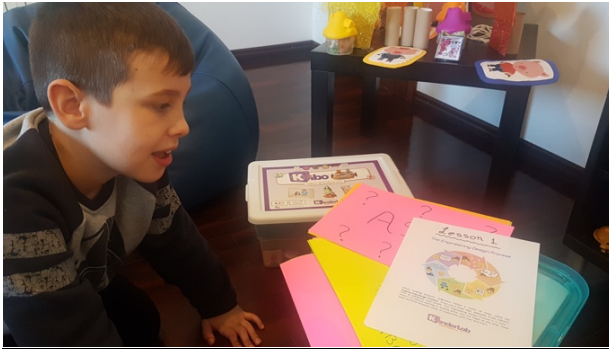
Powerful Idea: **What is the character of the story that can be programmed in the Robot? - Robotics with the KIBO Robot**

OVERVIEW:

In Lesson 2 we will discover the one that in the History of the 3 Little Pigs, one of the characters can help us to recount the complete story. This discussion of ideas with the group of children is essential so that after realizing what a Robot is, the child can decorate and program the robot to tell the story.

It is important that the children understand what a Robot is, what its parts are, how it can be programmed and how it moves. It is also important that children realize that they have an important role in the programming of the robot and that it is they who introduce the instructions (algorithms), which allows it to execute a sequence of actions.

In this lesson we present the KIBO Robot, all its components and the children try to assemble some of its parts, digitalize blocks and create a small program to perceive the movements of the robot.

Knowledge & Objectives

Prior Knowledge:

- Students will have previous experience in the area of computational thinking without technologies and involving the programming concepts that are expected for these ages.

Students Will Understand That:

- What is a robot and which robots do they know?
- They will be able to identify the parts of the KIBO Robot and how all the parts are assembled for its functioning
- That it is necessary to create an algorithm (sequence of simple actions), scan and then the robot execute the actions. It is important to highlight the start, end and motion blocks (right, left, front, back).

Students Will Be Able To:

- Define the character that will later be programmed to retell the story with the RobotKnow What Is A Robot?

- Know and be able to identify all parts of the KIBO Robot
- Try to assemble the KIBO robot and realize how it works (place motors, wheels, turn on, scan the blocks), so that the robot moves
- Program the robot in several steps, with the simplest programming blocks (front, back, right and left), allowing the child to see how the robot moves and executes a sequence of actions

Materials Needed:

- Stories for children about robots, for example, "The Robot Book" or "No-Bot, the Robot with No Bottom" or videos about Robots
- KIBO Robotic Kit
- Pictures of different part of the story
- White sheets, pencils and colored pencils
- 3D Scenario of the History of the 3 Little Pigs

Activity Description:

Warm-Up Activity (Time: 30 minutes):

It is important to start with a dialogue about what robots are and what robots' children already know. The Educator can show photos of some robots and talk about their characteristics.

If the Educator has some story or short film about Robots she can be part of this introduction moment, but not more than 15 minutes.

This warm-up time will give the children motivation to enter into the concepts more associated with Robotics. Children can design their idea about Robots.

Main Activity (Time: 60 minutes)

Main Activity is with the KIBO Robotic Kit and initially we let the children open the box and discover all the parts they find of the KIBO. The Educator must question all the parts they find out and understand if all the children follow these learnings.

It is important that the child recognizes the components of KIBO and is able to describe the functionality of each one, always keeping in mind the age of the children.

Children should recognize the main blocks and start by creating a small program with the movement blocks. It is important to emphasize the beginning and end blocks and allow the child to experiment with digitizing the

blocks as well. After this experimentation the child assembles the robot with the main parts that allow it to move.

Example of questions with the Children:

- Can you design me a robot?

- What can a robot do?

- Do you Know what part of a robot are?

- Can robots tell stories?

- What robots do you know?

- Can you build the KIBO robot?

- Tell me, what you are putting on your robot?

- Do you know how a robot works?

Concluding Activity (Time: 30 minutes)

Children share their doubts about the components of the KIBO robot and the programming blocks. The children share their ideas for future programming and discuss how they can program the "Wolf" robot to go to the 3 little pigs' houses. It is important to associate to this moment of knowledge of what a Robot is to the Curriculum Unit we are working on. The intention is, at the end of this lesson, that the child starts to think about the intentionality that the Educator intends to give to this curriculum, which is to learn to program through the retelling of a story, in this case, the 3 Little Pigs.

Lesson 2 Vocabulary

- *Robot* - a machine that can be programmed to do different things

- *KIBO Body* - the central part of the Robot where all the other components are connected

- *Motor* - the part of a robot that makes it move

- *Wheels* - the importance of the wheels for the robot to move on the ground

- *Power button* - the importance of recognizing when the robot is on and off

- *Batteries* - Necessary for the functioning of the robot and that children realize that they are the source of energy of the robot.

Assessments To Be Used:

- Photos and Video

- PTD new Engagement Checklist new Children (one for each age)

Activity Results (Photos and Video):
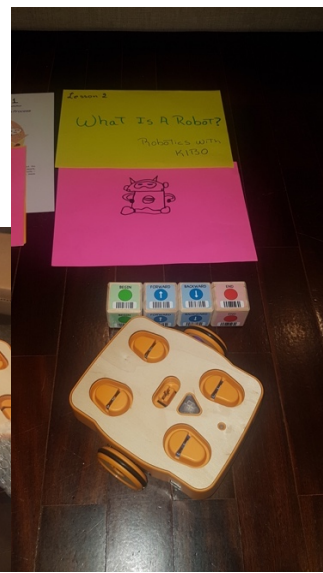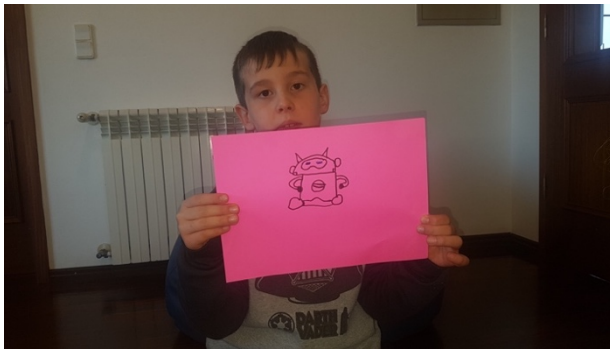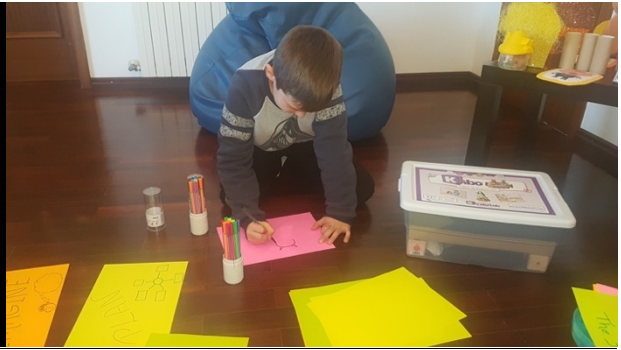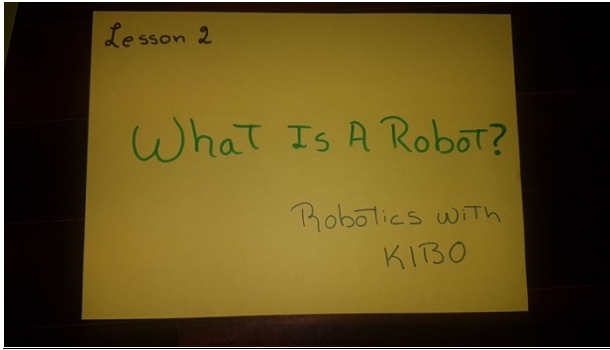
Powerful Idea: **The 3 Little Pigs story, with The KIBO Robot (the "Bad Wolf") – Programming: Control Flow by Sequencing and Instructions to program**

OVERVIEW:

In Lesson 3, children will learn What Is a Program? It is important that the initial exploration that was given in Lesson 2 moves to a consolidated learning about what the movement of the robot represents. The child in this lesson will understand that the movement of the robot is a sequence of instructions that determine its action. This learning about what is a program is associated to the retelling of the story of the 3 little pigs. After the children have the scenario of the story completed (the Forest and the 3 little houses of the 3 little pigs) it is important to define the paths that the robot will do.

Considering the global route that the Robot will have to travel, the Educator should encourage the children to divide the route into parts, for example, that the Robot (the "Bad Wolf") go to one little house at a time.

The children should look for the programming blocks necessary to create the program that allows the robot to reach each of the little houses. In the experimentation phase of the program, the children try to digitalize the blocks and test the program. In case the program doesn't work and the robot doesn't reach its destination it is important to debug the program to detect the error and it is important to experiment again.

Knowledge & Objectives

Prior Knowledge:

- Students will have previous experience in the area of computational thinking without technologies and that involves the programming concepts that are predicted for these ages
- The students have already explored the KIBO Robot, its components and programming blocks
- The students know well the story of the 3 little pigs and are able to define the path of the Robot (the "Bad Wolf") to recount the story

Students Will Understand That:

- Before programming the robot, it is important to understand which path they intend to program (computational thinking without technologies)

- Each block represents an instruction and should be introduced gradually, considering the age of the children and prior knowledge in the programming area
- A program is a sequence of instructions that is followed by a robot
- Mistakes when creating a program can happen and that these should be viewed as another learning opportunity

Students Will Be Able To:
- Define routes that the robot will have to take to get to the house of each one of the little pigs
- Program the robot with a complete sequence (go through all the houses)
- Understand what errors they encounter in programming, but also how they can simplify the algorithm and thus work on debugging

Materials Needed:
- KIBO Robotic Kit
- Pictures of different part of the story
- White sheets, pencils and colored pencils
- 3D Scenario (objects) of the History of the 3 Little Pigs

Activity Description:

Warm-Up Activity (Time: 30 minutes):

It is important that the children organize the scenario of the story of the 3 little pigs and in a large group define which routes the Robot has to take, so that the story can be told.

Each child individual or in a group can draw on the sheet of paper the scenario they built in the room and with the help of the pencil make a kind of journey on paper. This procedure can help the child to internalize the spatial notion that he or she will later represent in the program he or she will create.

The Educator can help to remember the directions and here we have an opportunity to learn the spatial-temporal notion that can be worked on, because the path is divided into different parts and moments of the story.

If the Educator prints the "icons" of the programming blocks in the size of an A4 sheet it can be important for discussion, with the group of children, to know the blocks better and to use them even on a table or wall to be more easily visible by all children.

This warm-up time will provide the children with knowledge about the programming blocks and feel safer to explain the program you are creating for the Robot.

Main Activity (Time: 60 minutes)

Main Activity is with KIBO Robotic Kit and the character (the Bad Wolf) who will go through the forest looking for the houses and the 3 little pigs.

The children will try to create the various programs for the robot (the Bad Wolf) to reach each of the houses. It is important to divide the program by parts, like this:

> 1. The children use the directional blocks of movement (front, back, right and left) to leave the forest and reach the first house (the Straw);
>
> 2. The second program is the sequence of actions that the robot will have to perform to move from the first house (the Straw one) to the second house (the Wood one);
>
> 3. The third program will be the sequence of actions that the robot will have to execute to move from the second house (Madeira) to the third house (Brick);
>
> 4. The fourth program will allow the Robot (the Bad Wolf) to escape to the forest, after not being able to "catch" any of the 3 little pigs;

At the end of trying to create these 4 programs it is important to put the image of the program of each of the parts posted on a wall. This way the large group of children can discuss and collaborate to find new ways to simplify the program.

We must realize that all this activity has to be considered and always have in mind the age of the children, their previous knowledge about programming and their maturity to understand more complex levels of programming.

If the Educator realizes that he can make this part of the activity even more difficult, then he can propose to the children that they try to create the complete program, so that the robot (the Bad Wolf) can go through all the houses, programmed with a single program.

Example of questions with the Children:

1. Do you know well the story of the 3 little pigs, which I just narrated?
2. Can you imagine the main parts of the story and create the scenario with these objects?
3. Which of the actors of the story will your robot be? Why?
4. Which is the path of your robot, the Bad Wolf, so that you can tell the story?
5. Can you plan your route on this sheet?
6. Can you create a program for the robot with the programming blocks?

7. Can you test the robot's programming and see if he was able to leave the Forest, go to all the houses and go back to the forest?

Concluding Activity (Time: 30 minutes)

The children share their doubts, about the programming blocks and the action sequence of the Robot (the Bad Wolf) identifying the mistakes and what they can do best in the next lesson.

It is important to give the children a voice and that they discuss and present their achievements and difficulties in a large group, providing one of the important parts The Engineering Design Process, which is "Share".

Lesson 3 Vocabulary

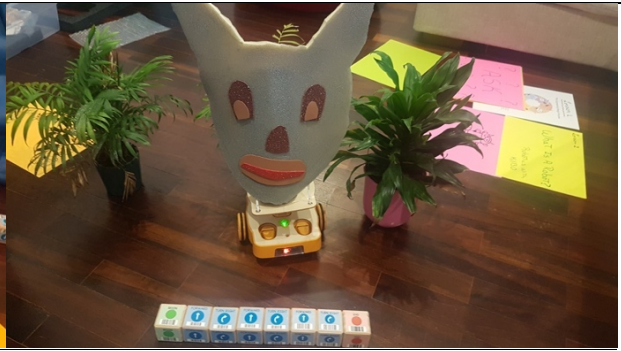- *Route* - the path you take to get to a certain place
- *Programming Blocks* - physical representation of an instruction
- *Program* – a set of instructions for a robot
- *Sequence* – the order of instructions that a robot will follow exactly

Assessments To Be Used:

- Photos and Video
- PTD new Engagement Checklist new Children (one for each age)

Activity Results (Photos and Video):
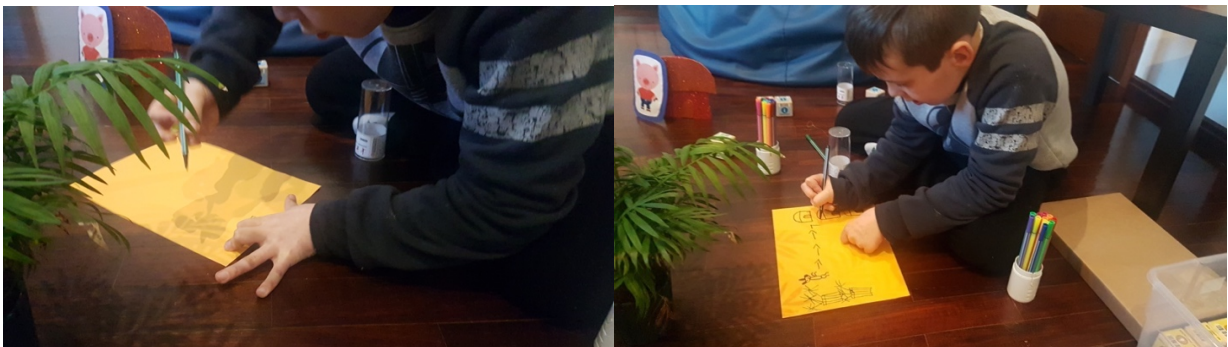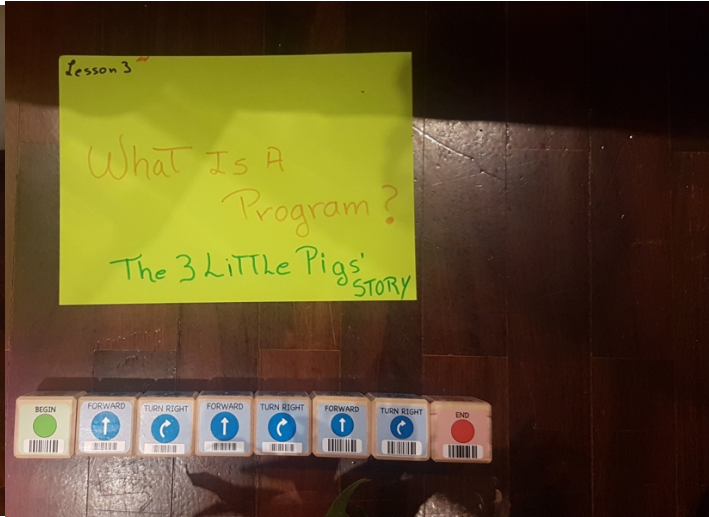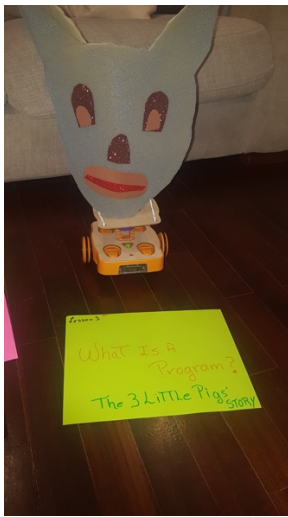
What are the 3 Little Pigs' Moments of History? - Learning with Sensors and Actuators

OVERVIEW:

In Lesson 4, children will have the opportunity to learn how to use the Sensor and the "Light Output" actuator. It's important to come to this lesson with the lessons from previous lessons consolidated. We should realize that the age range of pre-school children (4 to 6 years old) conditions the way all the components of robotics are worked at different ages.

In this lesson we begin the discussion of ideas with the whole group of children in order to analyze the programming that was done previously in lesson 3 and how we can introduce the Sensors. The child needs to learn that the Sensors are components of the Robot and that it can react to an external action, in a simpler way, the Robot feels something if it has sensors.

Let's start with the simplest sensors and the "Light Output" actuator:

1. "Sound" sensor and the block "Wait For A Clap" for example, so that the robot starts the action (The Wolf enters the Forest)

2. The "Light Output" actuator with the blocks of white, blue and red light, to mark each time the Robot arrives at each of the Little Houses

3. In the following lessons we can introduce the remaining sensors.

If the Educator considers it important to divide the children by working group, either by age or by mixed to carry out this lesson it is up to each one. It is important to look at what the children have already learned and provide new challenges in this lesson.

Knowledge & Objectives

Prior Knowledge:

- Students will have previous experience in the area of computational thinking acquired prior to curriculum development and previous lessons
- Students have already tried programming the KIBO Robot, with several programming blocks
- Students know the history of the 3 little pigs well and are able to define at what moment the "Sound Sensor" and the "Light Output" actuator can be introduced to mark important moments in the history.

Students Will Understand That:

- The "Sound" sensor and the "Wait For A Clap" block can allow you to mark an important moment in the retelling of the story

- A robot can feel and see its surroundings with a sensor.

- The robot can react when reaching a stage by showing a signal that marks the same stage, for example with the "Light Output" actuator.

Students Will Be Able To:

- Use the "Sound" sensor and the "Wait For A Clap" block at the beginning of the programming sequence

- Use the "Light Output" actuator every time the Robot ("Bad Wolf") passes in front of a House. The Child realizes that the KIBO robot has completed one stage of the programming.

Materials Needed:

- KIBO Robotic Kit

- 3D Scenario of the History of the 3 Little Pigs

- White sheets, pencils and colored pencils

Activity Description:

Warm-Up Activity (Time: 15 minutes):

In the first part of the activity it is important to remember the concepts associated with the components of the KIBO Robot and present the two sensors that are defined for this activity.

The discussion in large group about what is a Sensor is fundamental and if possible the Educator can demonstrate its functioning, so that later the children develop their ideas on how to use these sensors in the recounting of the story of the 3 Little Pigs.

Main Activity (Time: 90 minutes)

In Main Activity the child proposes different ways to use the sensors and it is important to test all the possibilities.

If there is more than one KIBO Robotic Kit in the room, the idea is to divide the group of children according to the number of Kits and allow new ways of programming with the sensors to be explored.

We should promote discussion every time a group of children tests a program with the sensors and record, for example, on a sheet or whiteboard the programs that are tested. In this way, the children visualize the program and adjust to new tests until they are satisfied with the programming and integration of the sensors.

As I mentioned before, the "Sound" sensor and the "Light Output" can serve to mark important moments in history, such as the beginning with the "Sound" sensor and the "Wait For A Clap" block and the "Light Output" actuator every time the Robot ("Bad Wolf") passes in front of a house, of the 3 little pigs.

Example of questions with the Children:

1. Do you know what a Sensor is?
2. How does the Robot know when the story begins?
3. Can you program the beginning of the story with a Sensor?
4. What programming block do you need when you are using that Sensor?
5. Do you want to create the program and test it?
6. How do I know that the Bad Wolf (your robot) has passed in each of the houses and has reached the end of its path?
7. Can you mark these passages with some actuator?
8. How is the programming with the actuators? Can you do and test?

Concluding Activity (Time: 15 minutes)

After the activity, it is important to reflect with the children. This lesson on sensors can take more or less time than expected and it is important that these adjustments take place so that there is no learning left to consolidate.

At this point of completion, it is equally important to motivate yourself for the next lesson on Repeats- Loops & Number Parameters. Children should create the foundation to pursue the curriculum and be motivated for new challenges.

**Lesson 4 Vocabulary**

- *Sensor -* The child is able to describe a "Sound" sensor when receiving a stimulus reacts and performs an action.
- *Atuadores* - The actuators emit a signal, such as the "Ligth Output", when the programming is so defined and you want to mark a moment.

Assessments To Be Used:

- Photos and Video
- PTD new Engagement Checklist new Children (one for each age)

Activity Results (Photos and Video):
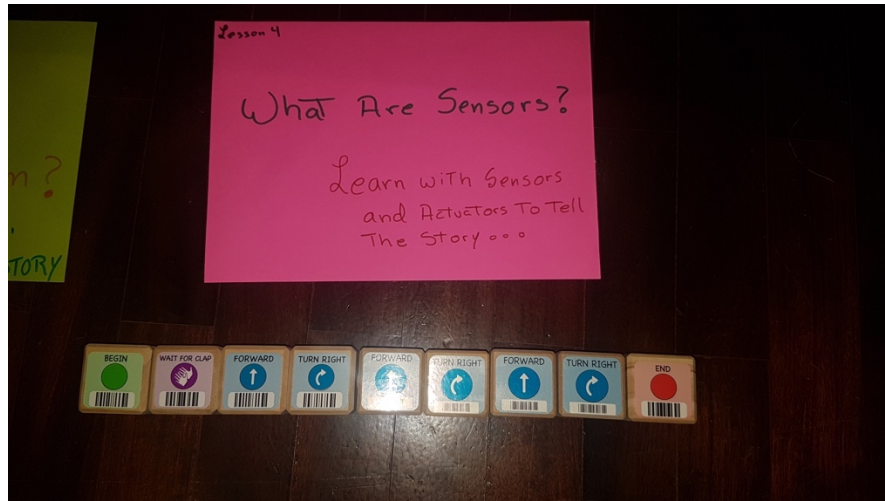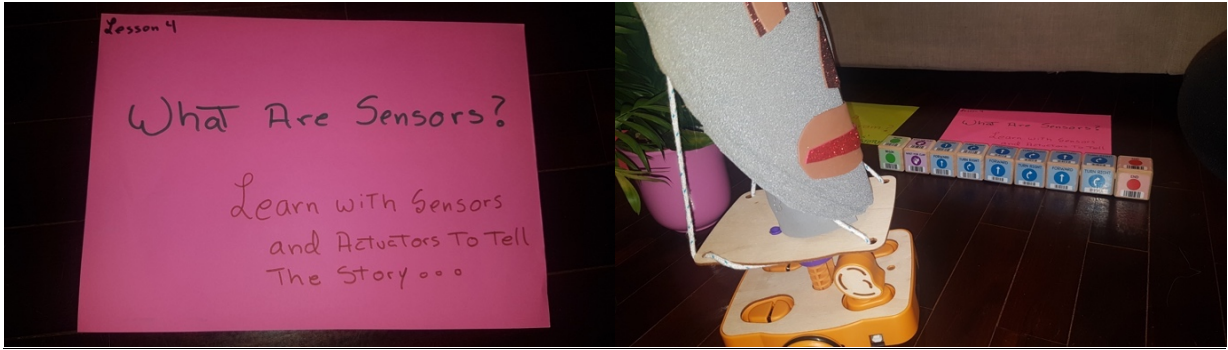
Powerful Idea: **What does the Bad Wolf do? - Recount the entire history of the 3 little pigs using the Repeats- Loops & Number Parameters**

OVERVIEW:

In Lesson 5, after children have learned to use a Sensor and an actuator, we move on to a more advanced level of programming. We began this lesson with a discussion of ideas with the entire group of children in order to analyze the programming that was done earlier in Lesson 4 and how we can simplify and clarify the programming that the children did.

We consider that these learnings should be for older children or children with previous knowledge of programming and robotics, even before this curriculum. However, it is always important to explore these programming blocks and understand how children deal with these learnings, whether simple or complex.

If the group of children has advanced in previous learnings and are prepared to learn new concepts, I consider that these learnings be introduced gradually. It is important that the child realizes that the use of the Repeats - Loops & Number Parameters blocks will allow them to simplify the programming sequence and structure their computational thinking with another maturity.

To retell the story the child may realize that the first sequence of the Robot can be repeated, for example, when the Robot goes from one house to the other and here should define the number of times it repeats the movement.

Knowledge & Objectives

Prior Knowledge:

- Students will have previous experience in the area of computational thinking acquired prior to curriculum development and previous lessons
- The students have already tried programming the KIBO Robot, with several programming blocks, with sensors and actuators
- Students know the history of the 3 little pigs well and are able to define at what point they can repeat sequences

Students Will Understand That:

- The program they initially created for the Robot to retell the story can be simplified
- The introduction of "Repeat" in programming is an additional information that can clarify the algorithm

Students Will Be Able To:

- Use the "Repeat Loops" blocks in programming situations that need to be simplified, for example, in the sequences where the "Bad Wolf" goes to each one of the houses
- Understand the advantages of using the loop blocks and a number of repetitions, so that the Robot ("Bad Wolf") is able to go from the Forest and go to each one of the "3 Little Pigs" houses.

Materials Needed:

- KIBO Robotic Kit
- 3D Scenario of the History of the 3 Little Pigs
- White sheets, pencils and colored pencils

Activity Description:

Warm-Up Activity (Time: 30 minutes):

To begin this lesson, it is important that the Educator dedicates the first part to reviewing the programs that the children have previously created, to program the robot to tell the story. As such, I suggest that:

1. Use the white board to draw or paste the programming blocks of each of the sequences that the robot performs to leave the Forest, then to go to the house of Straw, then to go to the house of Wood, go to the house of Bricks and finally go to the Forest

2. The visualization of each of the programs and the discussion with the group of children may allow them to reach the conclusions we need, so that they understand the sense of using the Repeats- Loops & Number Parameters

Main Activity (Time: 120 minutes)

The start of Main Activity is dependent on Warm-Up Activity and must also be worked on by parties:

1. The children will define the 5 courses of the Robot and identify in each one of them which parts repeat (try to discover the pattern that repeats): Leave the Forest; Go to the house of Straw; Go to the house of Wood; Go to the house of Brick; Go to the Forest

2. Children introduce Repeats - Loops & Number Parameters into various programs to simplify them

3. Children test the modified program(s), which may have been reduced to a single program in general, depending on the number of Repeats - Loops & Number Parameters. This procedure should be gradual so as not to make the learning too complex the first time

4. After testing it's important that the child shares his ideas and has the opportunity to "debug" the program until he achieves the goal of this lesson which is to retell the story of the 3 Little Pigs and that the Wolf (Robot) goes through all the parts of the story

This lesson, because it has a higher level of complexity in the learning intended to develop, can be accomplished in 2 or 3 days and devote more or less time than is suggested, because it is dependent on the development of each child and their maturity for the acquisition of these concepts.

Example of questions with the Children:

1. Do you know what repeats are?
2. Can you remember what the Robot's schedule was to go to all the houses?
3. Can we repeat some of the actions in this program you initially created?
4. Can the algorithm get smaller and simpler?
5. Do you understand why you are using the repeats?
6. Can you create a program using the repeats where you told me it was possible to do?

Concluding Activity (Time: 30 minutes)

Concluding activity should always promote dialogue, encouraging children to share their achievements and difficulties.

On the other hand, the Educator should understand if the concepts acquired in this lesson have been consolidated or if he or she needs to review these lessons before introducing the next lesson.

In this curriculum, lesson number 6 is more complex and may or may not be carried out at preschool, as it is aimed at older children who master the concepts learned from lessons number 1 to 5.

In this curriculum it is possible to go from lesson 5 to 7. This lesson is different because it includes new perspectives of the curriculum, so I would say that if an Educator considers moving from lesson 5 to 7 without performing lesson 6 it is because their group of children is not mature enough to understand the concepts that we will work on in lesson number 6.
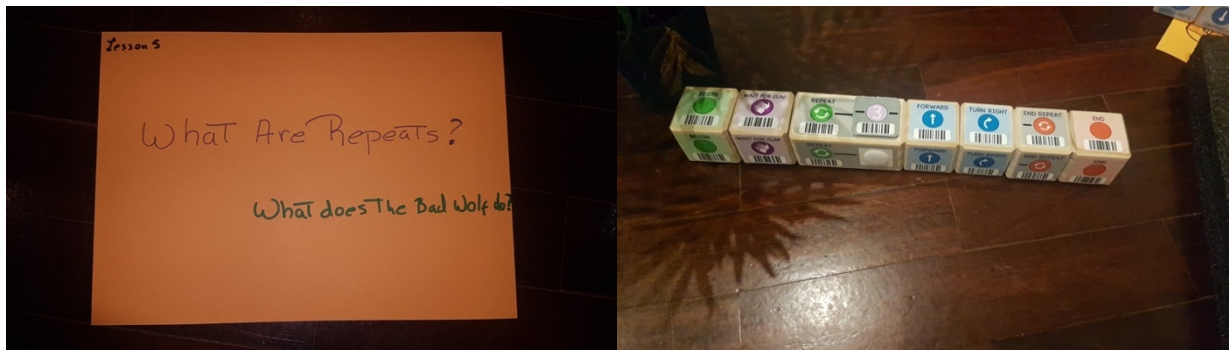
Lesson 5 Vocabulary

- *Loop* – something that repeats over and over again
- *Parameter* – a limit that a robot will follow
- *Pattern* – a design or sequence that repeats

- *Repeat* – to do something more than once

Assessments To Be Used:

- Photos and Video

- PTD new Engagement Checklist new Children (one for each age)

Activity Results (Photos and Video):

Powerful Idea: **Where is the Bad Wolf going? - Ifs- Sensors & Branches**

OVERVIEW*:*

Lesson 6 only makes sense for children who already have previous knowledge in the area of computer thinking, programming and robotics, and even then, to work with older children. This lesson no longer tells the story of the 3 Little Pigs, because it is told until lesson 5, however, in this lesson we can take the opportunity to introduce advanced programming concepts such as conditional.

As I mentioned before it is possible to go from lesson 5 to 7. This lesson 6 is different because it includes new perspectives of the curriculum, so I would say that if an Educator considers moving from lesson 5 to 7, without performing lesson 6 is because his group of children is not mature enough to understand the concepts that will be worked here.

The intention of this lesson is to review all the Robot programs from the previous lessons and see in each one how it is possible to introduce the distance or light sensors and that the Robot makes a choice, creating a non-linear sequence.

For example, in the History of the 3 Little Pigs the Wolf in the previous lessons was able to go to all the houses of the 3 Little Pigs and go to the Forest. The programming was done in a sequential and complete way, without ever considering "obstacles" that prevented the Robot from continuing his action.

In this lesson we can question the children about this problem of the robot finding obstacles and having to decide. Here we can enjoy when the Robot reaches a house and goes against it. If the child has to program the robot he will have to make the logical decision that "if the robot goes against the house, he goes back and follows the path".

Knowledge & Objectives

Prior Knowledge:
- Students will have previous experience in the area of computational thinking acquired prior to curriculum development and previous lessons
- Students have already tried programming the KIBO Robot, with several programming blocks, with sensors, actuators and using Repeats - Loops & Number Parameters

- The students know well the history of the 3 little pigs and are able to define at what moment the robot may need to complete a sequence and go back to follow the path.

Students Will Understand That:
- The robot when arriving to a certain place that was programmed by the child may have to opt for two situations, for example, stop or continue to another sequence of actions
- That there are sensors of the robot, which are used to establish a choice (Ifs and If Nots), during the sequence that the robot performs.

Students Will Be Able To:
- Use the "Light" actuator after completing the sequence, as a way to perceive the end of the whole journey through the forest and passing through the houses of the "3 Little Pigs"
- Realize that when the robot arrives at a house, it needs to identify this situation as a condition to be evaluated by the robot. For example, the robot when finding the first house turns around and continues the route. Here you can use the "If" and also the "Distance Sensor".

Materials Needed:
- KIBO Robotic Kit
- 3D Scenario of the History of the 3 Little Pigs
- White sheets, pencils and colored pencils

Activity Description:

Warm-Up Activity (Time: 30 minutes):

To begin this lesson, it is important that the Educator dedicates the first part to reviewing the programs that the children have previously created, to program the robot to tell the story. As such, I suggest that:

1. Use the white board to draw or paste the programming blocks of each of the sequences that the robot performs to leave the Forest, then to go to the house of Straw, then to go to the house of Wood, go to the house of Bricks and finally back to the Forest

2. The visualization of each of the programs and the discussion with the group of children may allow them to reach the conclusions we need, so that they realize the sense of using the distance sensors, light and learn the blocks of conditional "Ifs and If Nots

Main Activity (Time: 120 minutes)

The Main Activity can be divided into 2 parts and even on different days. The important thing is that the children understand the logical condition that is implicit in the programming of the robot.

The first part can be dedicated to the Distance Sensor (telescope) trying to improve the program that the child has already done in previous lessons, to program the robot when it arrives at the Pigs' homes.

In this part it is important to test the program several times, with the blocks "Ifs and If Nots" and the Distance Sensor to reach the final program that corresponds to the retelling of the History of the 3 Little Pigs, passing through the 3 houses and leaving, finally, the forest.

The second part of this activity can be dedicated to the Light Sensor (Eye), with the objective of explaining to the child that the Robot can walk the path until it reaches a dark place (which in this case can be the Forest), thus escaping the path to the forest. These challenges can be worked as examples, but it is also important to listen to the ideas and imagination of children. It is important to take the time to test the ideas and explain to the children what is happening.

In this lesson we can always prolong the main activity, depending on the motivation of the children, the difficulties and what we want them to learn, considering their age and maturity.

Example of questions with the Children:

1. Do you know what an "If" is?

Imagine that your robot arrives at a place that is very dark and doesn´t want to enter.

1. Can you program it so that the robot will stop when it reaches a dark place?
2. What programming blocks do you need?
3. What sensor do you use with those programming blocks?
4. Do you want to create the program and test it?

Imagine that your Robot arrives at a house and needs to decide where to go next.

1. Does the robot need a sensor to feel that it has reached the first house, turned around, followed its path and so on?
2. What programming blocks do you need to program the robot?
3. Do you want to test it?

Concluding Activity (Time: 30 minutes)

This activity can be concluded with a conversation with all the children realizing if they were able to perceive the story of the 3 Little Pigs when it was the Robot to tell, through the programming that they made.

It is important that the Educator encourages the debate about what they could not do, but also about what they want to do next and here we can always ask as a question:

- Do you want to program the Dance of the 3 Little Pigs, that after getting rid of the Wolf they celebrated in the Forest?

And yet,

- What other stories do you know that have "Wolves" and that the scenario is in the Forest?

From these two proposals the debate can be extended to the robot dance or to retell another story, enlarging scenery objects and new characters. Some stories that can be developed with a similar curriculum are: "Little Red Riding Hood", "Wolf and Seven Little Goats", "Peter and the Wolf", "Let's Play In The Forest While The Wolf Is Not Around".

Lesson 7 is dependent on the conclusion of this activity; however, we can always conclude the project with a Dance of the History of the "3 Little Pigs" and this is Lesson 7.
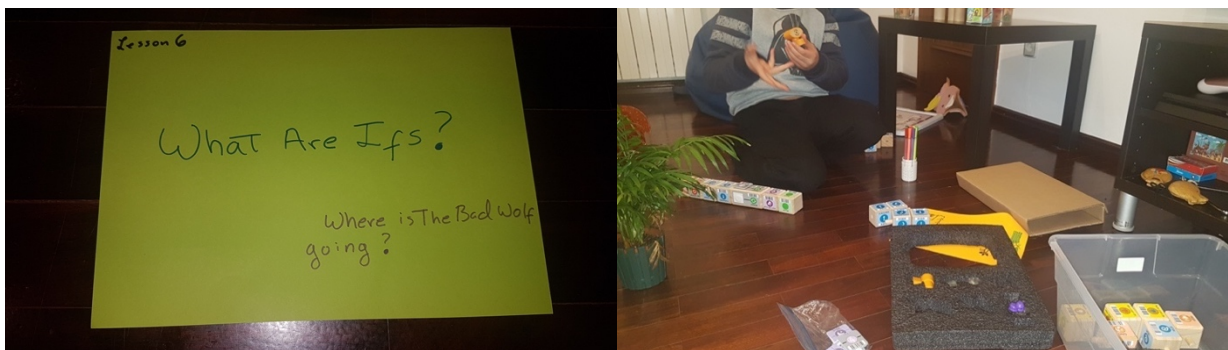
Lesson 6 Vocabulary
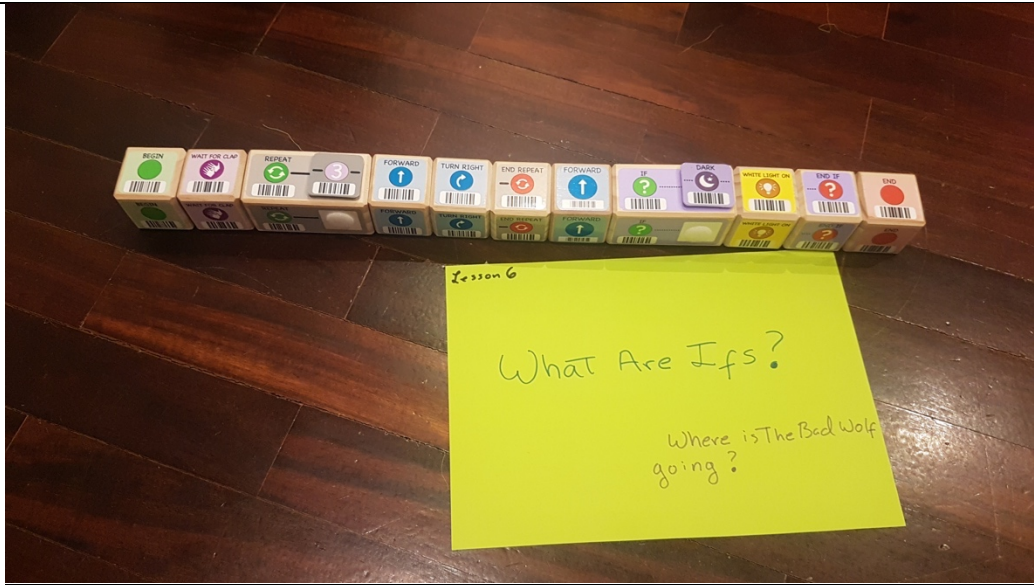
- *If*- Used for introducing a situation that may happen**.**
- **Distance sensor (telescope) -** allows to feel the distance the robot is in relation to an object
- **Light Sensor (Eye) -** allows to feel/see the Light in a certain space

Assessments To Be Used:

- Photos and Video
- PTD new Engagement Checklist new Children (one for each age)

Activity Results (Photos and Video):

Powerful Idea(s): **"The History and Dance of the 3 Little Pigs" and Other Stories of Wolf in the Forest**

OVERVIEW:

In this lesson we relive all the "Powerful Ideas from computational thinking and how they align with traditional early childhood concepts and skills" (Bers, 2018, p. 78), that is, Algorithm, Modularity, Control structures, Representation, Hardware/Software, Design Process and Debugging.

Lesson 7 is the conclusion of a whole project developed through the previous lessons, but with a special closing, which includes the History and Dance of the "3 Little Pigs".

This lesson, as a culmination of the project, should be shared with the local community (school community, family, friends, etc.).

For this lesson the Educator should encourage the children to prepare the final version of the presentation of the story, for a wider audience. And, also, add new elements such as the Dance that can be done with the Robot and the Children together.

Some more time should be devoted to this lesson, so that the children can re-enter the Engineering Design Process and feel confident before the final presentation.

Beyond this moment, which includes what was experienced in the previous lessons and the dance, the intention of this curriculum is to leave open the possibility of working on other stories, similar or not, with lessons as proposed here.

This curriculum is easily adaptable to other stories and that the objective is also to learn how to program to tell a story.

Knowledge & Objectives

Prior Knowledge:

- Students will have previous experience in the area of computational thinking acquired prior to curriculum development and previous lessons
- The students have already tried programming the KIBO Robot, with several programming blocks, with sensors, actuators, using Repeats - Loops & Number Parameters and Ifs and If Nots.
- The students know well the history of the 3 Little Pigs and are able to define at what moment the robot may need to complete a sequence and go back to follow the path.

Students Will Understand That:

- It is important to organize the ideas through Engineering Design Process and reach the last phase of sharing not only with your peers, but also with the community

- Through programming and robotics, it is possible to tell a story and make a dance with the Robot Programming and Robotics is also for preschool children and Coding as Literacy is possible" (Bers, 2028).

Students Will Be Able To:

- In the final project the child will be able to retell the story of the "3 Little Pigs", with the KIBO robot as the main character, the "Bad Wolf"

- To expand the Project, the Child can integrate one or three more robots, which would play the role of the "3 Little Pigs" and they would have to have a program to escape from the "Bad Wolf"

- Children can also explore the dance choreography, presented in the musical video

- Use the Robot ("Bad Wolf") as a character of other traditional stories, that the children know and here work the curriculum unit.

<u>**Materials Needed:**</u>

- KIBO Robotic Kit

- Engineering Design Process poster

- 3D objects that can be built with recyclable materials or others for each of the stories you want to work on

- White sheets, pencils and colored pencils

<u>**Final Project Activity - (6 horas):**</u>

The final activity should be divided into several parts, according to what was defined as the main theme of this lesson. If the goal is to create a presentation of the story to the community and a dance, then the process should be to organize how to do it and an example of this could be this division of work:

      1. Organize what will be presented from the story and remember the concepts from the previous lessons for the presentation (2 hours)

      2. Prepare the Robot dance together with the children to end the story retelling (2 hours)

      3. Final presentation of the story and dance for the Local Community (Family School, Friends)

If the objective is to retell another story of Wolf in the Forest, as examples given in the previous lesson, it is important to consider the previous knowledge of the children. The Educator can dedicate this lesson to work with the children the lessons he considers necessary to retell another story. Here the 6 hours of Final Project

should be divided by the lessons that the Educator considers that he should work with the children, given the motivation and maturity of the children.

Example of questions with the Children:

1. Do you know how this story ends?
2. Would you like to create the Dance of the 3 Little Pigs to celebrate the end of the story?
3. Do you know other stories that have a wolf?
4. Would you like to do another project with the robot with another story?

<u>Vocabulary</u>

- *Design* – a plan for a building or invention. As crianças experimentam o palpe de gestores de um grande projeto

- *Engineer* – someone who invents or improves things. As crianças constroem e experimentam o que desenvolvem

- *Story's* – Traditional stories and their narrative, which allow the development of language, imagination and creativity

- *Story Characters* - Identification of characters and their characteristics

- *Action/Sequence* - Children are able to describe the actions and sequences of each of the characters

- *Robot* – a machine that can be programmed to do different things

- *KIBO Body* – the central part of the Robot where all the other components are connected

- *Motor* – the part of a robot that makes it move

- *Wheels* – the importance of the wheels for the robot to move on the ground

- *Power button* - the importance of recognizing when the robot is on and off

- *Batteries* – Necessary for the functioning of the robot and that the children realize that they are the source of energy of the robot.

- *Path* - the path that one takes to reach a certain place

- *Programming Blocks* - physical representation of an instruction

- *Program* – a set of instructions for a robot

- *Sequence* – the order of instructions that a robot will follow exactly

- *Sensor* - The child is able to describe a "Sound" sensor when receiving a stimulus reacts and performs an action

- *Actuators* - Actuators emit a signal, such as the "Light Output", when the programming is so defined and you want to mark a moment

- *Loop* – something that repeats over and over again

- *Parameter* – a limit that a robot will follow

- *Pattern* – a design or sequence that repeats

- *Repeat* – to do something more than once

- *If*- Used for introducing a situation that may happen**.**

- **Distance sensor (telescope)** - allows to feel the distance the robot is in relation to an object

- **Light Sensor (Eye)** - allows to feel/see the Light in a certain space

Assessments To Be Used:

- Photos and Video

- PTD new Engagement Checklist new Children (one for each age)

Final Project Showcase (Photos and Video):

Final Reflection of my Curriculum Unit

Throughout this semester I had the opportunity to learn a lot, through reading suggestions, videos, online educational resources and discussions with classmates and teachers.

This final work gathers the inspiration of everything I learned, but that could be better. I am always learning and it is on this learning path that I reach the culmination of a stage with more ideas and the desire to continue learning. This Curriculum Unit was designed for kindergarten children, with the aim of developing skills associated with children's literature, through programming and robotics. The combination of several curricular areas to work the areas of STEAM makes perfect sense and I hope that the contribution of this work will help Kindergarten Educators to unblock fears and enigmas, regarding programming and robotics.

We live in a world impregnated with technologies, which can be used in our pedagogical and family contexts to develop "Powerful Ideas". Scientific research in this area of programming and robotics in early childhood is not of today and this research has given evidence of great contributions to the development of children. According to Marina Umashi Bers (2018) "Powerful Idea are intellectual tools. They evoke an emotional response. Children can make connections between powerful ideas and personal interests, passions and past experiences. Early childhood education has paid particular attention to promoting learning environments in which children can make connections (p. 174 and 175).

In my Curriculum Unit, which I worked with Robot KIBO to consolidate the knowledge of a well-known traditional history (The 3 Little Pigs), can be the basis of a curriculum to be worked other traditional stories. The intention is to leave a set of lessons that allow the child to learn how to program the KIBO robot, while they dedicate themselves to tell a story known by them.

To complement the written work, I made a final video that exemplifies the development of this curriculum. The ideal would have been to implement the curriculum in a kindergarten classroom, with children between 4 and 7 years old for approximately 3 weeks, for a total of 20 hours. However, due to the current world situation, here in Portugal access to kindergartens is restricted and hygiene rules do not allow the sharing of materials, which makes it impossible to implement this project in an educational context. Due to this situation I have recreated in my home the development of the curriculum, with the participation of my son who recently made 8 years old. He knows the KIBO robot at least and the structure of the curriculum was developed for the purpose of delivering the final work.

In the future, I hope to implement this curriculum in kindergarten and clearly understand its potential and limitations. However, we must remember that this curriculum must always be adjusted to the children's ages and development, as learning gradually increases from levels of difficulty. Each Educator should adjust the curriculum to their group of children and consider the lessons they may or may not realize with the group of children. I hope

that I have made a positive contribution to the future of integrating programming and robotics into kindergarten and that this is just the beginning of a journey filled with activities and learning that motivate and engage children in STEAM areas.

Enhancing children's creativity and imagination should be a priority throughout life, thus seeking personal and professional self-realization. But everything starts from the time the children are born and goes on afterwards in kindergarten being this a privileged place where everything is possible to realize. According to Resnick (2017) "As the kindergarten children play, they learn many things. As they build towers, they develop a better understanding of structures and stability. As they create stories, they develop a better understanding of plots and characters. Most important, they learn about the creative process, and they begin to develop as creative thinkers" (p. 11).

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