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Senior Project Reading Reflection

Empowering Education by Reasoning with Robots: LEGO to the Future

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LEGO Engineering Education with Sixth Graders: Exploring Basic Concepts and Use of Robotics in Medical Rehabilitation

September and October were planning months in my senior project design process. I researched my first classroom activities using the books, *Designing for Learning* by George Gagnon Jr. and Michelle Collay, and *Captivating your Class* by Joanne Philpott. In conjunction with my teaching research, I also researched robotics in rehabilitation by analyzing Giulio Rosati's, Eng PhD, articles titled "The Place of Robotics in Post-stroke Rehabilitation" and "Upper Limb Rehabilitation Robotics After Stroke: A Perspective from the University of Padua, Italy." The culmination of my readings was the design of my first day lesson plan for Ashley Hall fifth graders, and also an informative opportunity to join MUSC robotics engineers and neuroscience researchers for a luncheon and conference with visiting guest Dr. Giulio Rosati.

My lesson plans follow the Constructivist Learning Design Theory which states that "education is a natural process" in which children are learners who think individually to make personal connections with events, think collaboratively to create shared meaning of events, connect prior knowledge to learning events, pose questions, respond, communicate their ideas, and reflect upon their thinking processes during learning events (Collay and Gagnon). There are

six elements to creating a lesson plan following the Constructivist Learning Design: situation, groupings, bridge, questions, exhibit, and reflections.

The situation is described by Collay and Gagnon as the "purpose of the learning episode", or what the learners (students) take away from the classroom activity (7). For the first day I want my students to understand my goals for our activities, and set goals of their own. I also want them to eventually understand basic robotic engineering and its applications to science and math. The students will be grouped in pairs because I am only working with four girls at a time. We will trade off partners so that the girls get a chance to work with everyone in the group.

The bridge is defined in *Designing for Learning* as an activity that demonstrates students' prior knowledge and bridges it into the current classroom event. It is mostly for the teacher's perspective of his or her students. I chose a fun, challenging activity for the first class that implements the Engineering Design Process, and provides students with a solvable task requiring skills they will use later for LEGO building and programming. In my activity the students will have scissors, paper clips, plastic baggies, and a small paper weight or magnet. They will be asked to design parachutes and draw out their designs.

Following the classroom activity, the students will answer a set of guiding questions that provide insight into the purpose of the challenge. According to Philpott in *Captivating your Class* the teacher should ask a question and wait for a response. By "increasing the wait time," studies found that pupils' answers were longer, failure to respond decreased, responses were more confident, and alternative explanations were offered (66-67). After responding to questions, students will reflect upon their struggles and strengths, and exhibit a written description of their thought process throughout the activity. After the activity, I will present the students with

questions that I have prepared, such as how they chose a design, and allow them ample time to sketch their thought and planning processes.

In tandem, I researched Dr. Rosati's use of robotics in rehabilitation following his presentation at the Medical University's Health and Research Building. According to Dr. Rosati, who works in the Department of Innovation in Mechanics and Management at the University of Padua in Italy, reducing stroke impact on elderly patients is becoming a "primary societal goal" due to an aging population in developing countries (753). The first pioneering robotic system for rehabilitation processes was made in 1995. Since then researchers have been searching to successfully validate the use of these devices.

According to *Upper Limb Rehabilitation Robotics after Stroke*, rehabilitation robotics is an "emerging research field aiming to employ leading-edge robotics technology and virtual reality systems in the rehabilitation treatment of neurological patients" (981). There is a lack of data to show improvements in functional recovery for patients who have suffered a stroke, but there have been positive results in terms of motor recovery (Carraro et al.) Rosati confirms that robotic systems have improved the clinical outcome of rehabilitation and reduced treatment costs. This is the major reason for continued testing and reform of robotic devices; robotics offers a cost-effective use of human resources because one therapist can oversee the therapy of several patients at once (Rosati 755). Some future engineering challenges highlighted by Rosati and the other authors are: to design exoskeletons that allow freedom of movement for natural and functional movement ability, to make sure the robotic joints match up with the patient's joints because every person has a different body, and to explore the relationship between sensory feedback, like sounds and visual signals, and improved patient engagement and effort in therapy sessions.

I drew a parallel between Dr. Rosati's idea for gait sonification in rehabilitation robots and the use of the LEGO Mindstorm education kits. My goal is to connect what we build and program in the computer lab with the future plans for rehabilitation therapy. For instance, Dr. Rosati said in theory, a beep would sound when a patient had made a full step, or had successfully moved his or her arm to a target. The LEGO kits contain an ultrasound sensor that triggers a song or light when the robot has reached a certain distance from an object. We could easily build a robot that would move a certain distance, and play a song as a reward stimulus for moving. This is exactly what rehabilitation engineers are attempting to do with their robotic systems. The sounds, or visual signals, would act as stimuli for the patient and reinforce improvement in functional motor ability. This type of connection between real world application and classroom activity is what I want the girls to see and understand by the end of my project.

Works Cited

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Lesson Plan 1: The Journey Begins

Empowering Education by Reasoning with Robots: LEGO to the Future!

1) Teaching Methodology:
   a) ***The Constructivist Learning Design***
   b) Maria Montessori –"Education is a natural process spontaneously carried out by the individual, and is acquired not by listening to words, but by experiences upon the environment." ~Intro of *Designing for Learning*
2) **Situation**
   a) The purpose of our first class will be to identify the goals for our meetings and activities, learn about who engineers are, some advantages of robotics
   b) The task that will arrange this purpose:
      i) They will watch YouTube clips of robotics contests and LEGO builds to excite them about this class
      ii) We will do a fun, hands on activity using the Engineering Design Process that will stimulate their curiosity for engineering and help them identify important skills
      iii) Activity- hands on, with pre planning sketch and description, and post-activity reflection/discussion
3) **Groupings**
   a) Always groups of 2- partners with switch midway through classes
   b) 4 students total
4) **Materials**
   a) For the activity we do
   b) Lab notebook
   c) Pens and pencils
   d) Folder for hand outs
5) **Bridge**
   a) We will first discuss topic and class goals
   b) Then we will watch You tube videos and talk about ideas
   c) The hands on lab will show me prior knowledge and communication skills
6) **Reflections and group discussion**
   a) "What did you feel when doing this activity?"
   b) Take home message
   c) Goal for next time we meet→ look at LEGOs, explore building options

Specifics

1. Introduce the Course: who I am and what we will be doing
2. What is LEGO engineering??
3. What is engineering and why is it important?
4. What do robotic engineers do? You are now a Robotics engineer!!
5. Show Videos:

http://www.youtube.com/watch?v=HC786zuiPj0

http://www.youtube.com/watch?v=LD1EOHYIdd4

http://www.youtube.com/watch?v=RlsAh2BTBgE

➔ **Acticles for Therapy/Robotics :** http://www.kidsahead.com/subjects/1-robotics/articles/116

http://www.kidsahead.com/subjects/1-robotics/articles/120

DESIGN A PARACHUTE

What you'll need:

- A plastic bag or light material
- Scissors
- String
- A small object to act as the weight, a little action figure would be perfect

Instructions:

1. Cut out a large square from your plastic bag or material.
2. Trim the edges so it looks like an octagon (an eight sided shape).
3. Cut a small whole near the edge of each side.
4. Attach 8 pieces of string of the same length to each of the holes.
5. Tie the pieces of string to the object you are using as a weight.
6. Use a chair or find a high spot to drop your parachute and test how well it worked, remember that you want it to drop as slow as possible.

What's happening?

Hopefully your parachute will descend slowly to the ground, giving your weight a comfortable landing. When you release the parachute the weight pulls down on the strings and opens up a large surface area of material that uses air resistance to slow it down. The larger the surface area the more air resistance and the slower the parachute will drop.

Cutting a small hole in the middle of the parachute will allow air to slowly pass through it rather than spilling out over one side, this should help the parachute fall straighter.