

Using Robotics to Explore Problem Solving and Higher Order Thinking Skills among Middle School Students

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1. Introduction

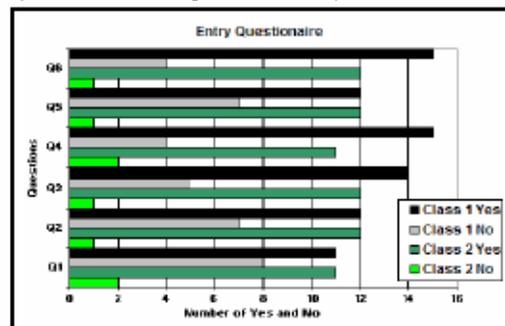
Problem solving, higher order thinking? What are they? To define these skills one must look at what is needed by employers of employees to perform and make decisions on their own. Most children today do not possess the skills of problem solving and higher order thinking. In schools across America teachers are struggling to teach these skills. This research tests a theory of using robotics to define and teach these skills to two seventh grade classes. The intent is to help students' proficiency in higher order thinking and problems solving become a more automatic response. These skills will be useful in the students' education as well as life experiences.

2. Experiment, Results, Discussion, and Significance

This study is being conducted with two classes of seventh grade students. The first class consists of 19 students. Class 1 has 3 students who are in special education, while the remainder is on grade level 7. Class 2 consists of 13 students in which 10 out of 13 are in special education, with 3 on grade level 7. The students were introduced to the concept of working with LEGO robotics at the beginning of the nine week course. Both classes have completed an entry survey, which allowed me an understanding of what the students want to become in the future and how they prefer to learn. The questions not only have given me a point to start with, but also allow me to explore the thinking and problem solving skills for their future careers. The questionnaire consisted of six "yes" and "no" questions which were;

1. Do you like school?
2. Do you like to play with Lego?
3. Do you like to build things?
4. Do you like to work with computers?
5. Would you like to work with Lego?
6. Would you like to learn how to use a computer?

Figure 1. Class 1 compared to Class 2 yes and no answers.



As you can see there are far more yes's than no's to the questions. This informs me, the children are excited to learn for this study. If I had begun this study with more no's than yes's, the experiment would have been null.

Along with the yes and no questions, the questionnaire consisted of two other questions; 1. How do you like to learn? (a) book (b) lecture (c) hands-on (d) other. 2. What field of work do you want to work in when you grow up? (a) science (b) engineering (c) laborer (d) medical (e) business (e) economics (f) other. For each of the types of work, I placed examples beside each word, for instance, with science (ex. biologist, geologist) so the students were able to have a choice of what types of jobs are associated with the education major. I had to add a category, not thinking about students who chose the career in specialties such as professional sports, acting, or singing. The new category named "other" was placed in Figure 3 due to this problem.

The purpose of questions are for me to know how the students enjoy learning the best. In fact, looking at the outcomes, more than 75% of the students in special education prefer the hands-on types of learning. Surprisingly lecture and "other" came in next with learning from a book being the least preferred.

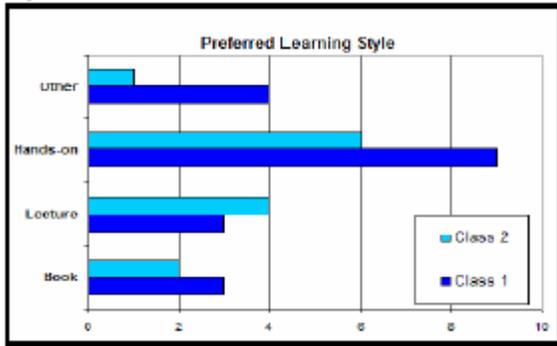


Figure 2. Preferred Learning Styles

The purpose of question 2 is to allow me to know how the students feel of what they are able to accomplish. So many times children are told they will only be able to do this or that, therefore using this question I can see most of my students feel as though they are able to become engineers and doctors. You will notice great discrepancies between Class 1 and Class 2.



Figure 3. Career Choices

Students in both classes are now very knowledgeable about an online learning community called, “Blackboard.” All lessons and journals are kept electronically so the student may go home and do work as well. I have made great use of the online “Discussion Board” in which I pose a discussion, and students respond to the topic and must also respond to one other fellow students’ post. One topic we have already discussed was, *What is your definition of problem solving? Give an example with your definition.* Here are some of the responses I have gotten; (a) *Problem solving is when you have a situation that needs to be worked like when you do Lego robotics for example. Such as if the robot keeps turning the wrong way, you have to think it out and change it.* (b) *When you have to figure something out. Also when you have to think about the problem. Also when you are having problems you do all the steps.* The online learning allows students to say things like *I don’t know* or *I am not smart enough*,

which are some real posts from the above topic.

The next step in this study will be to identify what problem solving and thinking skills are. “There are two essential dimensions of thinking that students need to master in order to learn how to upgrade their thinking. They need to be able to identify the *parts* of their thinking, and they need to be able to assess their use of these parts of thinking,” (Elder & Paul, 1997). The two classes will examine the parts of their thinking by solving problems and making a list of what skills they used to solve it. We will then look at different aspects of the skills they name and see if they have optional tasks.

The students will have three robots to build and program using Robolab (LEGO, 1998). We will use build the robots using LEGO Mindstorms kit pieces. They will also maintain a journal using BlackBoard, and through the use of the discussion board, students will keep posting to topics, which will promote higher levels of thinking on the students’ part. The assessment process will be done through the use of teacher observations, student journals, team journals, completed robots, completed missions, and a completed exit questionnaire and reflection.

3. Reflection

One goal for this study is to help the students identify problem solving and higher thinking skills in order to solve problems in life. While maintaining focus on the goal, the students will be using the educational skills of language arts, mathematics, and science. Standards from these curricula will be completed as the students complete each activity. This will also be assessed through daily journals as students will make an effort to identify which standard they meet during the daily activity.

I feel as though robotics is an awesome way to teach and utilize students’ skills in thinking about and solving everyday problems. The SCANS 2000 report describes what employers need employees to have when they enter the workforce. I will follow the SCANS report and correlate it with the skills the students gain from this experience. The outcomes will show how, by the use of LEGO robotics, students will be more prepared to enter today’s society.

4. References

- [1] L. Elder and R. Paul, *The Elements of Critical Thinking*, (The Foundation of Critical Thinking) Dillon Beach, Ca., 1994.
- [2] LEGO DACTA(R) ROBOLAB(TM) V. 2.0.1, (The LEGO Group) 1998.
- [3] *What Work Requires Of Schools; A SCANS Report For America 2000*, (U.S. Department Of Labor) Washington, D.C., 1994.