

# THE INCLUSION OF ROBOTS WITHIN THE TEACHING OF PROBLEM-SOLVING: PRELIMINARY RESULTS

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## ABSTRACT

*This poster considers the first six months experience of using Mindstorm (LEGO, Denmark) robot kits to teach problem-solving. Robots were used as necessary foundation studies prior to teaching the syntax of a programming language (Java). Results of students' response to this approach are presented together with suggestions for future developments of this method.*

## Keywords

*Problem-solving, robots, student experience.*

## 1. INTRODUCTION

Mindstorm based robots have successfully been used for teaching programming to computing and engineering students [1, 2]. As part of the teaching of problem-solving in a first year programming module, the role of using robotics is under investigation. Preliminary results are presented here.

## 2. METHODOLOGY

The approach has taken the form of six exercises with gradually increasing difficulty, one of which formed part of the summative assessment. The assessment comprised of two tasks, one involved the student producing a list of instructions to enable the robot to trace a letter 'm'. The assessment task was also developed further in the programming assignment where the same exercise was repeated, but as a graphical simulation. For the first assessment a simple set of instructions was given for the control of the robot and templates for each of the exercises into which the instructions could be incorporated (figure1).

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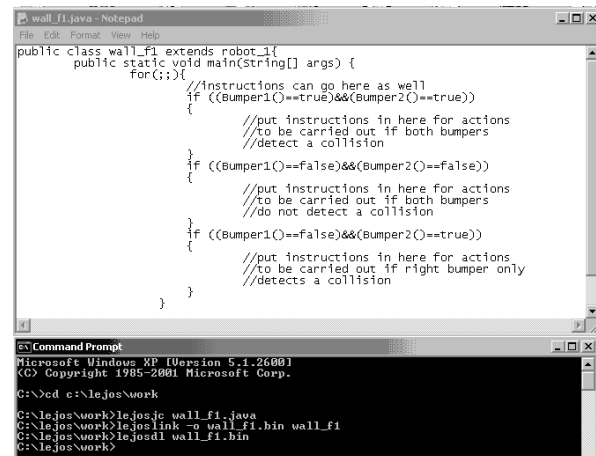
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Two questionnaires were used as part of the evaluation of this investigation. The aim of the questionnaire at the beginning of the module was to ascertain student's initial thoughts and concerns with problem-solving. The second questionnaire was conducted after the robot exercises with the aim to gauge the response to inclusion of robots for teaching problem-solving.

## 3. PRELIMINARY RESULTS

### 3.1 Questionnaire 1

The most common response to concerns about problem-solving was that they had no concerns 30%. In 33% of replies the comments indicated concerns with either missing important or 'obvious' information; or how far to breakdown the problem. These responses suggest that confidence building needs to be addressed when teaching problem-solving.



```
public class wall_f1 extends robot_1{
    public static void main(String[] args) {
        For(i);{
            //Instructions can go here as well
            if ((Bumper1()==true)&&(Bumper2()==true))
            {
                //put instructions in here for actions
                //to be carried out if both bumpers
                //detect a collision
            }
            if ((Bumper1()==false)&&(Bumper2()==false))
            {
                //put instructions in here for actions
                //to be carried out if both bumpers
                //do not detect a collision
            }
            if ((Bumper1()==false)&&(Bumper2()==true))
            {
                //put instructions in here for actions
                //to be carried out if right bumper only
                //detects a collision
            }
        }
    }
}
```

```
C:\>cd c:\lejos\work
C:\lejos\work>lejosjc wall_f1.java
C:\lejos\work>lejoslink -o wall_f1.bin wall_f1
C:\lejos\work>lejosdl wall_f1.bin
C:\lejos\work>
```

Figure 1. Template for the wall-following routine and downloading the routine to the robot.

### 3.2 Questionnaire 2

88% of respondents said they enjoyed the exercises and 12% responded neutrally. Most of the students (71%) who replied said they believed the exercises did help with their confidence in problem-solving. The most common reason stated (50% of replies)

for how the robot approach has helped, was given as the robot provided either a visual or physical representation of the problem. In 15% of the replies on how the approach could be improved, the suggestions made can be summarised as the need to increase the challenge of the exercises. Some of the other suggestions included “better robots” (10% of replies) and more testing time (5%). Additional robot kits have been purchased to address this last point by allowing increased access and experience of the robots. The most common reply (50%) on how the approach could be improved was a neutral one either no comment or “no idea”.

### **3.3 Assignments**

The assignments for the two parts of the module were linked; one student commented on their module feedback stating that there was a “Good progression from problem solving to java”. Preliminary results suggest a slight improvement from last year’s results of problem-solving from a C- to a C, more analysis is needed to look at the nature of this effect.

## **4. CONCLUSIONS**

The preliminary results suggest that this approach is worthy of further investigation based on the

indicative increase in grades and the positive response of students. The improvements to the approach that were suggested by the student can be summarised as an increase in the number and difficulty of the exercises.

More analysis and further comparative data is needed to evaluate this approach against last year’s results and to reduce bias due to the ability of the cohort.

## **5. ACKNOWLEDGEMENTS**

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## **6. REFERENCES**

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