

National Literacy and Numeracy Week 2009 Project Report

Project title: Robomaths - Robotics Intervention
<p>Project description: Robotics has proven itself to be a very effective tool in increasing the motivation of identified underachievers at St Therese. The success students are experiencing in Robotics has enhanced the academic self-efficacy of many disengaged and underachieving students.</p> <p>The project aimed to:</p> <ul style="list-style-type: none"> • Increase motivation of students, especially targeting identified underachievers. • Assist students to develop positive attitudes towards problem solving and mathematics. • Enhance academic self-efficacy of students by providing a link between interest areas (Robotics and technology) and academic areas (literacy and numeracy). <p>The students worked through a variety of robotic based challenges and identified the problem solving strategies and mathematical concepts they utilised. The students were constantly asked to verbalise their thinking and were given specific performance feedback. The tasks were modified to enable students to experience success (mastery) in all Robotics tasks.</p>
<p>Person responsible for project: Tracy Burns (Gifted and Talented Resource Teacher)</p>
<p>School, region, diocese: St Therese Primary School Sadleir CEO Sydney Southern Region</p>
<p>Contact person's email: tracy.burns@sttsadleir.catholic.edu.au</p>
<p>Number of students, teachers, parents, other community members directly involved:</p> <p><i>Students:</i> 45 Students from Year 6 completed the program. 40 students from Year 5 completed two of the Robomaths challenges during Literacy and Numeracy week. 4 gifted and talented students from Year 2 completed one Robomath activity.</p> <p><i>Teachers:</i> 6 Year 5-6 Class Teachers, the Librarian and the Gifted and Talented Resource Teacher</p> <p>Once the unit of work was completed, the students demonstrated their understandings to the wider community and other students in the form of a presentation day.</p>
Intended literacy and/or numeracy outcomes:

Numeracy:

DS3.1 Displays and interprets data in graphs with scales of many-to-one correspondence.

WMS3.1 Asks questions that can be explored using mathematics in relation to Stage 3 content.

WMS3.2 Selects and applies appropriate problem solving strategies, including technological applications in undertaking investigations.

WMS3.3 Describes and represents a mathematical situation in a variety of ways using mathematical terminology and some conventions.

WMS3.5 Links mathematical ideas and makes connections with and generalizations about existing knowledge and understanding in relation to stage 3 content.

Literacy:

TS3.1 Communicates effectively for a range of purposes and with a variety of audiences to express well-developed, well-organised ideas dealing with more challenging topics.

TS3.2 Interacts productively and with autonomy in pairs and groups of various sizes and compositions, uses effective oral presentation skill and strategies and listens attentively.

Evidence of achievement of intended literacy and/or numeracy outcomes:

Teacher Observation:

- Students worked collaboratively in a group. Student selection of groups assisted with the positive, fun atmosphere of the Robomaths sessions. Most students selected peers of a similar ability level. (TS3.1, TS3.2)
- Student discussions demonstrated a high level of understanding of the tasks that were undertaken and an improvement in their ability to identify the problem solving strategies and mathematical concepts utilised in the sessions. (TS3.1, TS3.2, WMS3.5)

Journal:

- The journals outlined the problems encountered, strategies used, and successes of each group. (DS3.1, WMS3.5, WMS3.2)

Challenge Activity:

- The Robomaths challenges designed by the students, demonstrated their ability to apply mathematical understandings and skills to different situations. (WMS3.1, WMS3.2, WMS3.3, WMS3.5)

Evidence of the increased motivation and enhanced self-efficacy experienced by the students can be found in the samples of work, photos and video of the presentation day.

Other information:

Additional information attached:

- Robomaths program
- Photos

Feedback about making grants available for such projects:

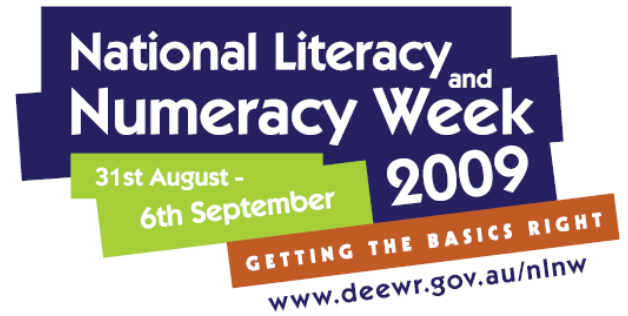
The grant enabled St Therese to purchase additional Robotics kits. The increase in Kits enabled the class teachers to integrate Robotics activities into the Mathematics curriculum.

The positive outcome of the project clearly demonstrates the benefits of utilising technology and interest based (motivational tools- such as Robotics) in the regular curriculum.

See below:



An Australian Government Initiative



Robomaths Program: Tracy Burns
School: St Therese Primary School Sadleir

UNIT TITLE: Robomaths			STAGE: 3			DURATION: 9 lessons		
KLA LINK: Science & Technology Investigating Designing and Making Using Technologies			Mathematics Data Space & Geometry: Position Time Working Mathematically: Problem Solving			English Procedural Recount Reading Writing Talking and Listening		
OUTCOMES								
MATHEMATICS:								
SGS1.3 Manipulates, classifies and draws two-dimensional shapes and describes side and angle properties								
DS3.1 Displays and interprets data in graphs with scales of many-to-one correspondence.								
WMS3.1 Asks questions that can be explored using mathematics in relation to Stage 3 content.								
WMS3.2 Selects and applies appropriate problem solving strategies, including technological applications in undertaking investigations.								
WMS3.3 Describes and represents a mathematical situation in a variety of ways using mathematical terminology and some conventions.								
WMS3.5 Links mathematical ideas and makes connections with and generalizations about existing knowledge and understanding in relation to stage 3 content.								
NS3.2 Selects and applies appropriate strategies for addition and subtraction with counting numbers of any size.								
NS3.3 Selects and applies appropriate strategies for multiplication and division.								
NS3.4 Compares, orders and calculates with decimals, simple fractions and simple percentages.								
ENGLISH:								
TS3.1 Communicates effectively for a range of purposes and with a variety of audiences to express well-developed, well-organised ideas dealing with more challenging topics.								
TS3.2 Interacts productively and with autonomy in pairs and groups of various sizes and compositions, uses effective oral presentation skill and strategies and listens attentively.								
SCIENCE AND TECHNOLOGY:								
DM S3.8 Develops and resolves a design task by planning, implementing, managing and evaluating design processes.								
INV S3.7 Conducts their own investigations and makes judgments based on the results of observing, questioning, planning, predicting, testing, collecting, recording and analysing data, and drawing conclusions.								
UT S3.9 Evaluates, selects and uses a range of equipment, computer-based technology, materials and other resources to meet the requirements and constraints of investigation and design tasks.								

LANGUAGE:

Robot, Input, Output, Ports, Download, Program, Sensor, Control, RCX Brick, Rods, Connectors, Pins, Wheels, USB Tower, jumps, loops, modifiers, power levels, NXTs.

Degrees, distance, full turns 360, straight lines, reflex angles, external angles, acute, obtuse angles, distance, time, 2D shapes,

RESOURCES: (including computer technology)

MindStorms Lego Kits, RoboLab computer program, library computers, Mindstorms computer program, excel, graph paper, calculators

Some of the activities may be found in the following teachers resources:

- Bratzel,B (2007) *Physics by Design*, College House Enterprises, Knoxville USA
- Wang.E (2007) *Engineering with LEGO Bricks and Robolab*, College House Enterprises, Knoxville USA

ASSESSMENT:

Teacher Observation:

- Students working collaboratively in a group
- Sharing of their experiences with others

Journal:

- Students record their results each session, including the following, problems encountered, strategies used, and successes.

Challenge Activity:

- Students design their own challenge to complete.

MODIFICATIONS\ EXTENSION:

Modifications: Students experiencing difficulty in programming will work in a small group assisted by the teacher. Student mentors are also available to assist students each session. Teacher and student demonstrations and sharing sessions are included in each lesson to assist students in developing the problem solving skills necessary to produce a high quality product.

<u>INDICATORS</u>	<u>TEACHING LEARNING ACTIVITIES</u>
<ul style="list-style-type: none"> • Knows and understands rules and procedures regarding the Lego Robotics. • Identifies equipment correctly. • Explains what robots are, where they have been used and where they have seen them. • Designs and builds a stable robot using sensors. 	<p>Lesson 1</p> <ul style="list-style-type: none"> • Introduce the unit 'Robomath' - outline some of the tasks the students will be undertaking. • Organise groupings of students (student choice) and allocate each group a number. Each group is to use the same box every week and is responsible for the contents. • Go through rules, procedures. • Pre-test - Students are asked to record a response to the questions and to record everything they know about the RCX or NXT robots, (this may include icons, pointers, helpful hints, problem solving methods, etc.) <ul style="list-style-type: none"> - Why is spatial awareness important in robotics? - Why is Mathematics necessary for programming robots? - How can problem-solving strategies be used to develop and produce computer programming solutions? • Students share pre-test reflections and as a class discuss the different components of the kit, their names and what they are used for. Moves and problem solving techniques are also discussed. (e.g.: shimmy, snake, turns, and figure eight.) • Students work as a team to construct a robot, using their equipment. The robot must be stable, have a touch sensor and allow for easy access to the control panel.

- Identifies icons.
- Understands and uses computer terminology.
- Students are familiar with On-Off button, Run button and Program button, Built-in Program 1, Output Ports A and C
- Shares work with others.
- ◆ creates regular and irregular two-dimensional shapes
- ◆ identifies and compares properties of isosceles, equilateral and scalene triangles.
- ◆ explores by measurement - angle properties of squares, rectangles, parallelograms and

Lesson 2-3

- Review 'inventor' and explain what each of the icons mean.
 - Open Inventor 4: Demonstrate : Palettes, Wiring, Space bar, Tab, Replace and insert, Ctrl B Broken arrow, Text box, Modifiers (discussing default values)

CHALLENGE 1: THE GREAT SHAPE CHALLENGE: ROBOSHAPES.

Part 1: Discussion:

- Identify and classify angles as right, acute, obtuse, reflex, straight or a revolution.
- Revise Degrees - 180° Straight angle, 90° right angle, 360° revolution, less than 90° acute angle, greater than 90° but less than 180° obtuse.

Task 1: Revolution 360° turn

Students Program their robot to complete a full turn or circle (must finish facing the same way you started - i.e.: 360 degree turn).

Part 2: Brainstorm:

- Using the smartboard name and draw two-dimensional shapes.
- Discuss properties of each shape.
- Identify angles contained in each shape, classify angles as right, acute, obtuse, reflex, straight or a revolution.
- Discuss how long it took the robots to complete a 360° turn. Question students as to how they could use this information to assist in programming robots to complete other shapes/turns.

Challenge Task: (Assessment)

Students Program their robot to create a 2D shape, e.g.: square, triangle, and hexagon. Students may only trial their program by running their robot four times (this may be adjusted depending on the experience of the group). This encourages the students to utilise a variety of problem solving strategies rather than relying on trial and error methods.

rhombuses

- ◆ Draws a line graph to represent any data that demonstrates a continuous change, e.g.: time vs. distance.
- ◆ Uses data to make predictions.
- ◆ Collects data to solve a particular problem.

- Collects large amounts of data in an organized fashion.
- Solves a probability problem
- Interprets data in graph form to make generalizations.

- creates a program of their own, uses a touch sensor and related Wait for icon.

Lesson 4-5

CHALLENGE 2: PARKING SPACE

Part 1: Discussion

- Discuss the 'Stop for Pedestrian' challenge that students completed earlier this year. Question students as to the strategies they employed.

Challenge Task:

"There is a secret parking space saved for you on this 3m road. All you have to do is find it.

You will have time to practice driving on the road and time your robot driving different distances. Using excel make a table and graph of your results.

At the end of practice time you will be told where your parking space is and you will be able to adjust your program but you will not be able to run your robot to check the timing is accurate."

Task taken from Physics by Design (Bratzel 2007:7.11).

Lesson 6 - 7:

CHALLENGE 3: VOTING MACHINE

Part 1: Demonstration:

Demonstrate how to use 'investigator'

Complete this activity first as a whole class demonstrating how to upload data and view the two sets of data on a graph.

Challenge Task1:

Students create a voting machine by attaching two touch sensors onto the RCX or NXT.

Students select a question that they want their classmates to answer. (This may be integrated into a HSIE, Science or health unit.)

Students answer(vote) their classmate's questions.

Students upload the data onto their computer and analyse results. (Bratzel.B, 2007:6.16)

Challenge Task 2: Do you have a sister?

In groups of four students use their voting machine to complete the "Do you Have a Sister?" activity from the book *Physics by Design*.

Analyse results, form generalizations as a class.

Lesson 8:

CHALLENGE 4: CREATE YOUR OWN

Students create their own robo challenge, students must:

1. Record predictions and plan before programming or running their robot.
2. Outline the mathematical concepts utilised in planning and programming and the strategies used to overcome any problems encountered.

Lesson 9:

Students complete evaluations and reflect on the skills and understandings gained through the unit.

Revisit the pre-test questions: (Brainstorm answers as a class or in small groups.)

- Why is spatial awareness important in robotics?
- Why is mathematics necessary for programming robots?
- How can problem-solving strategies be used to develop and produce computer programming solutions?

Present the Robomaths challenges to a wider audience. (Parents, teachers and students K-6).

- creates a robomath challenge.
- Identifies strategies utilised when solving problems.
- Identifies mathematical concepts used when programming.

Journal examples for recording problems encountered and strategies utilised:

1 st Attempt:
2 nd Attempt:
3 rd Attempt:
4 th Attempt:

Record some of the program you created.

Achieved: Y / N

Teacher signature:

Record any problems/difficulties your group encountered.	Record any successes (what did you do well?)
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Record some of the program you created.

Record some of the program you created.

Achieved: Y / N

Teacher signature:

ROBOMATHS ST THERESE PRESENTATION DAY PHOTOS



The students presented to a variety of audiences.

The students explained the problem solving strategies and mathematical concepts utilised in the Robotics challenges.



The students worked in teams to create their own Robomath challenges.