Robotics in Education eJournal

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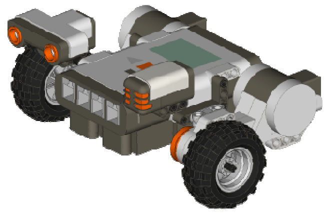
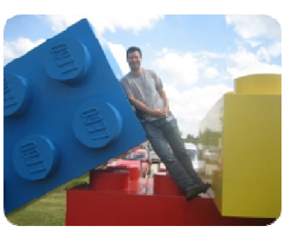
Compiled by Damien Kee – Domabotics



Robotics in education is fast becoming a popular way to engage students in the fundamental STEM concepts (Science, Technology, Engineering and Math). This eJournal brings together articles from teachers from all over the world who are using Robotics in different and exciting ways. Please join us on the *Robotic in Education* mailing list, and let us know how you have been using robotics in your classroom.

Contents:

Damien Kee – *Robotics in Education* mailing list coordinator and moderator.



Dr Damien Kee holds a PhD in Robotics and Bachelor of Electrical Engineering from the University of Queensland. Damien has been heavily involved with the RoboCup Junior competition since 2001, currently serving as Chairman of RoboCup Junior Australia and Technical Chair : RoboCup Junior International – Rescue League

He has been running robotics workshops in Queensland, Australia and Internationally for students and teachers since 2002 and has worked with over 1000 teachers and countless more students.

The Corridor Challenge

Chris Bracken
Tasmania - Australia

The following activity comes from the soon to be released book for Robotics teachers *Educate NXT* written by Chris Bracken (with contributions from Rob Torok and Damien Kee) to be published by LEGO Education USA and available worldwide through LEGO Education suppliers.

Educate NXT will be an ideal NXT robotics resource for teachers and students. Graded Student worksheets are accompanied by extensive Teacher sections covering topics including Navigation, Line follow and Sumo. This is further supported by animated PowerPoint presentations, ideal for teachers new to robotics, or teachers with experience wishing to extend their students. Two years of worldwide research and trialing has gone into preparing the book that meshes educational outcomes with LEGO robotics. Teachers will find out how to successfully and confidently manage a robotics program within their school. A wide-ranging series of Additional challenges round off an NXT resource that will give educators control within the robotics classroom yet foster learning freedom and the buzz of student engagement.

The activity "The Corridor Challenge" is one of the Additional challenges in the book. It is designed for students who have worked through many of the earlier worksheets in the book and are looking for an extra challenge. I ran "The Corridor Challenge" at my school, MacKillop Catholic College in Tasmania, Australia, in 2009 as part of our RoboClub program. The activity ran over 4 weeks (1 afternoon a week) and a highlight for me was many of the advanced NXT programming concepts that the students learnt and were also highly engaged with.

Figure 1: Obstacle Avoidance NXT Robots

The aim of this challenge is for students to program their robots to navigate down a corridor avoiding obstacles (a photo of this occurring at MacKillop Catholic College is shown in Figure 1). Whilst initially the activity can be introduced as an opened ended challenge, a variety of discovery learning steps can be introduced as the programming challenge increases. Some optional extension ideas are also featured at the end of the article.

An Ultrasonic senor (Figure 2) can be added to the EduBot (as shown on Page 28 – 30 of the NXT Building Guide Booklet). The EduBot is the name used throughout *Educate NXT* to describe the "driving base" robot found in the NXT Building Guide booklet and Robot educator, which is a feature of the Education version of the NXT-G software.

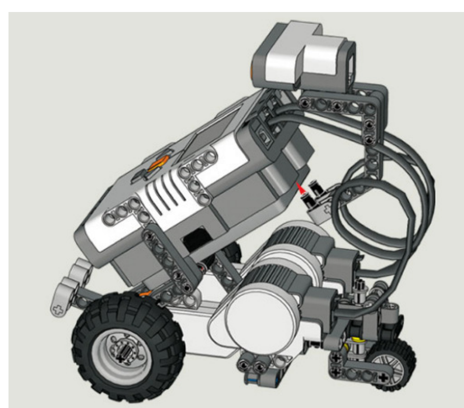


Figure 2: Ultrasonic module from NXT Building guide attached to the EduBot.

Initially students can be encouraged to program their robot to move forward until it detects an obstacle. This can be done using an Ultrasonic switch in NXT-G. Once the object is found they can get their EduBot to stop. Figure 3 shows this program.

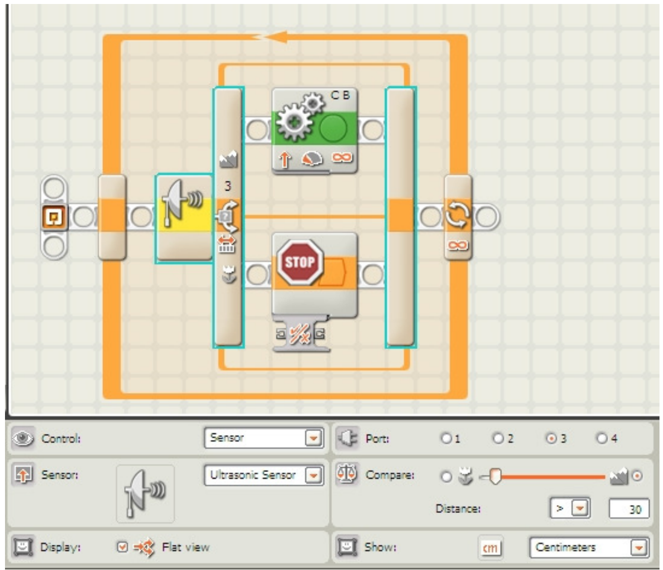


Figure 3: Obstacle recognition and stop program.

What to do once the Ultrasonic sensor detects the obstacle? (This can be a good brainstorming exercise). Students will likely come up with turn right or left, travel a specified distance then turn back towards the end of the corridor and check for a clear path.
The program in Figure 4 shows the blocks involved in detecting an obstacle, turning right to avoid obstacle, before hopefully continuing up the corridor.

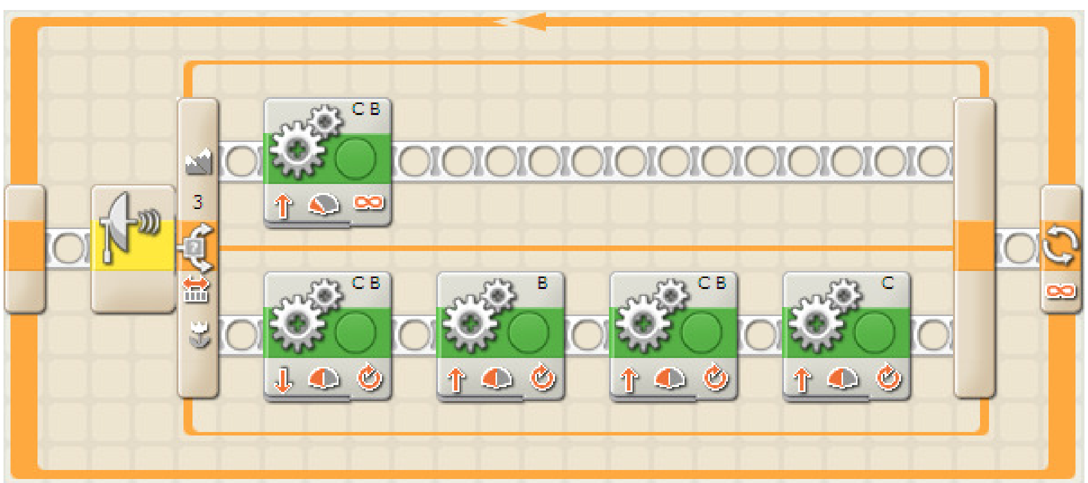


Figure 4: Right turn taken when obstacle detected.

Once trialed, students will soon realize that they will run into the wall (on the right hand side) with this program as shown in Figure 5.

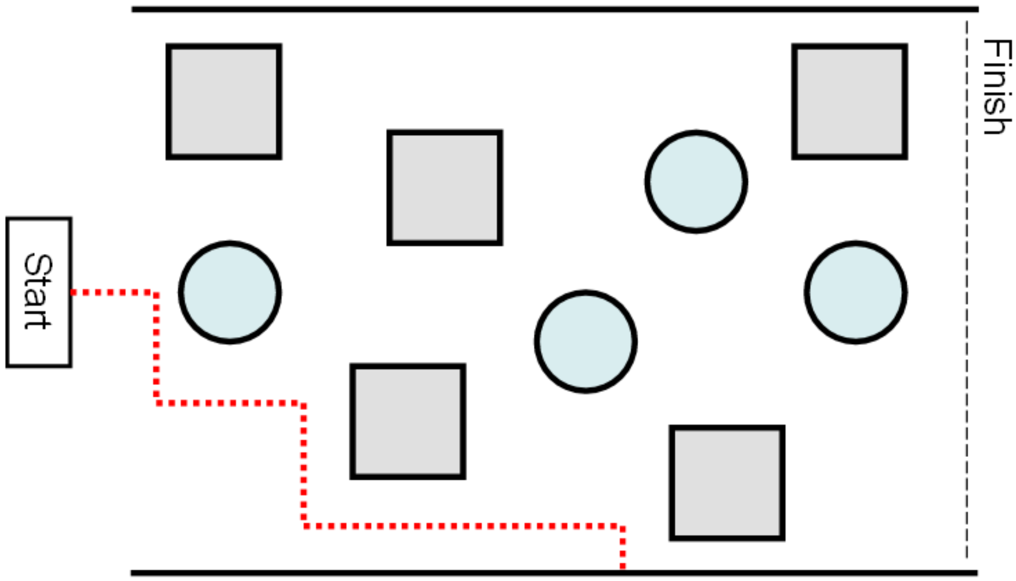


Figure 5: Path of a robot that turns right when obstacle detected.

Expect students to realize that they need to turn right at the first obstacle detection and turn left on the second obstacle detection, continuing in this pattern up the corridor in a manner similar to that shown in Figure 6.

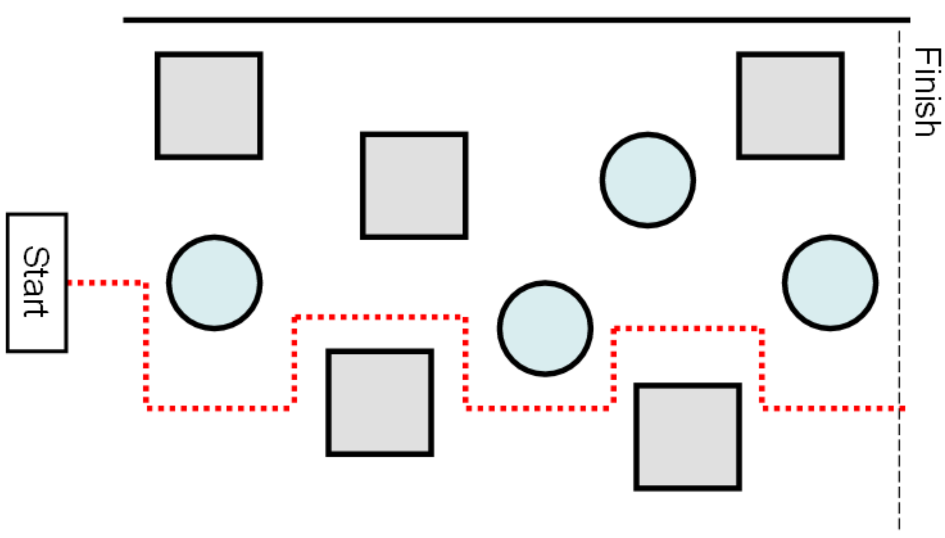


Figure 6: Right/Left Obstacle detection.

Programming a robot to take alternate right and left turns is tricky, but it is worthwhile encouraging students to try and brainstorm a solution (Suggest using a combination of Switch, Loop and/or Wait for blocks). Figure 7 shows a possible solution. A "turn left" branch is initiated at the Switch block when the Ultrasonic sensor first detects an obstacle. A Wait for (Ultrasonic sensor) block preceded by an "unlimited" move block is placed in the middle of this branch – detection of an obstacle by the Wait for block results in a right turn sequence for the robot. The entire switch is place in a loop to ensure indefinite left then right turns up the corridor.

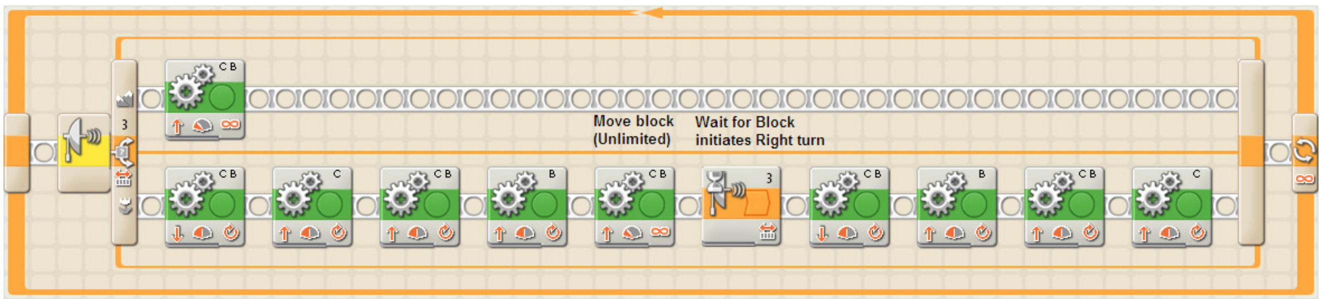


Figure 7: Left then Right turn obstacle avoidance program.

Extension

The Corridor Challenge opens up a range of possibilities for extension work. Presented here are ***Timer addition*** and ***Twisted head***

Timer addition

The addition of a touch sensor (with an activation bar) at the front of the EduBot can introduce the possibility of a timed run up the corridor. An on screen timer can be programmed to stop, along with the robot, if the robot strikes an obstacle. As the timer will be running throughout the challenge it needs to be programmed in parallel to the obstacle avoidance program. The program (for Right turning only when an obstacle is detected) is shown in Figure 8 and contains the following features:

- The Math block is used to divide the timer value by 1000 to change to seconds.
- The number value is changed to text by the Number to text block
- This value is then displayed on the NXT screen.
- When the touch sensor is pressed, the motors stop turning and the time is displayed on the screen.
- Pressing the Enter button or grey (back) button on the NXT brick will conclude the program.

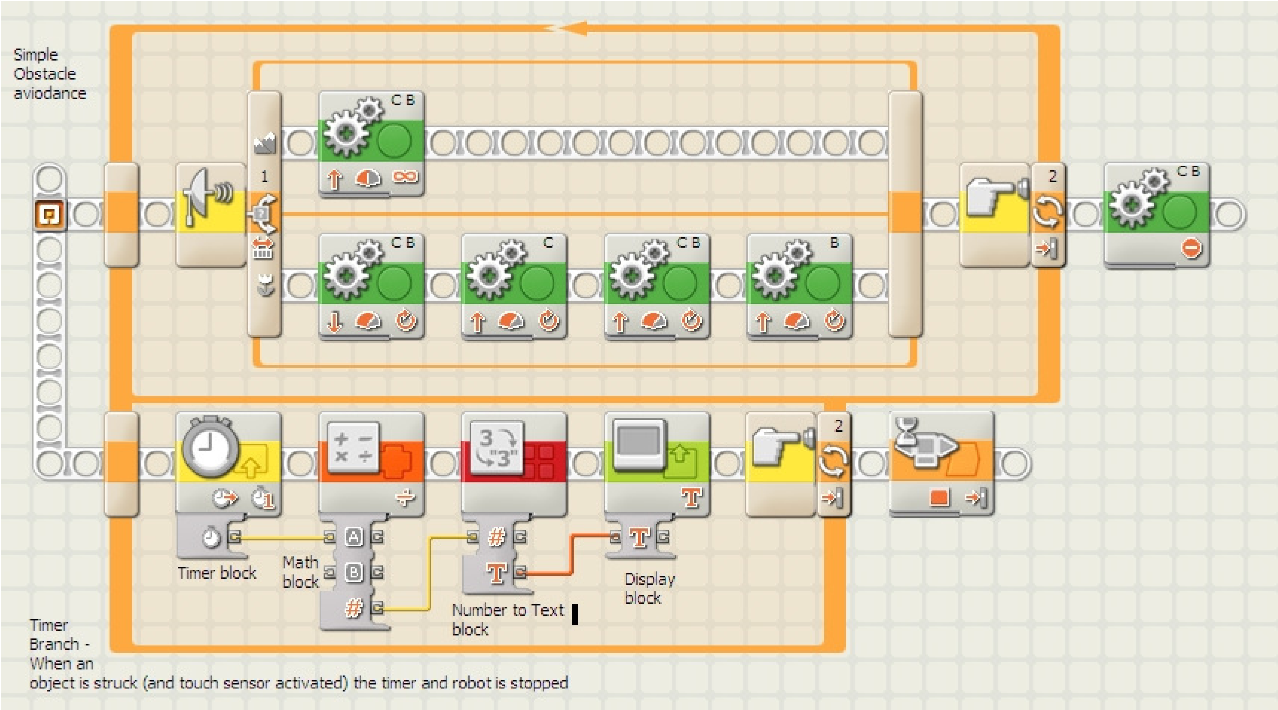


Figure 8: On screen Timer added to Obstacle avoidance program

Twisted Head

The ultrasonic sensor, used to detect upcoming obstacles can be attached to a 3rd motor on the EduBot, as shown in Figure 9a and 9b. The motor controlled ultrasonic sensor is programmed to point straight ahead down the course throughout the challenge, even when the EduBot turns left or right. The advantage of this is that when an object is detected and the EduBot turns to avoid it, the ultrasonic sensor can search for the next available gap, before turning towards the "finish line". This addition provides a terrific building and programming challenge for more advanced students.

Figure 9a and 9b: Twisted Head in two different positions.

Concept formation and role playing:
on-going robotics projects and preliminary results

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Middle and High Schools

1. Introduction

Many successful Lego-based projects started during 2009 in Catania School District, taking advantage of the consolidated *MiniRobot* competition for high school students (www.minirobotics.org)[1]. In this joint effort, the author is mainly devoted to projects addressed to middle schools.

Giving a new start to afterschool projects, the author and his colleagues decided to add some new educational aspect to the activities, in order to gain new insight into its effectiveness for students.

This paper is mainly a picture of the ongoing projects and the new features introduced with respect to 2009 projects. Projects will end on April/May 2010.

2. How it all started.

The author is involved in the management of the *MiniRobot* (www.minirobotics.org) competition for high school students of Catania (ITALY) School District. The competition began as a natural evolvement of the robotics courses the author and his colleagues pioneered in a number of schools, as volunteers, since 2003. Its first edition was in 2006, as a joint event of the larger Eurobot 2006 (www.eurobot.diees.unict.it)[2] competition, for university students, held in Catania in that year.

Then, following the suggestions of the Italian Ministry for Education and the experience gained during these last years, the author proposed a collaboration with middle schools in the district, in order to get feedback from headmasters and teachers.

The answer was positive in almost all cases: irrespective of their background, principals soon understood the real value of a robotic course in their school setting, as an invaluable tool to help students gain better competencies in logical and critical thinking, mathematics, collaboration among peers, communication, etc. More exactely, none of the first three schools accepting the project had a principal expert in math, science or technologies in general. One of them is a pedagogical expert, the second is a literature expert, and the third is an art and painting expert.

3. Planned new features for 2010 courses

- First of all, one of the main goals of educational settings and efforts is to give students a better and more autonomous gain of concepts they use. Both science and math based activities or other subjects spanning the field of humanities and arts deal with the process of concept formation in each student mind. So a simple request arises: how can an educator know better the learning process his/her students are undergoing ? Are they really understanding what they are doing ? Many robotics–in–school advocates claim for a far better understanding when activities are marked as “learn–by–doing” or “learn–by–design”. But can we give a clearer statement of the achievements gained by this kind of activities ? The author (who is also an high school teacher of mathematics and physics) is gaining a very positive experience using concepts maps for his students. The application of this pedagogical tool for robotics was a natural outcome of his experience. The ongoing results are presented in Section 4.
- After that, a new characteristic arose in 2010 courses: not all the participants were at their first experience with Lego–based activities. A small number of them have already participated to 2009 courses, and the rest were just starting from scratch. So, how to manage new groups appropriately ? We will report pros and cons of the experience the author is obtaining in a school with this mixed

[1]The site is still in Italian.
[2]The competition changes its location every year, around the world.

setting. This is addressed in Section 5.

4. Robotics concepts formation in students

Part 1 – Goals

Is it enough that students build their robots and report they are really happy with this activity ? How and what have they learned from their efforts ? A large research field is working to understand better and better the educational achievements of students when they face new concepts or work with ideas already possessed but eventually applied to new settings.[3] A pedagogical way to better assess what/how students learn is provided by concept maps: they give a fast and finer-grained view of the process of concept formation in students, analyzing different characteristics of the concept map created. For example:

- how many concepts did the students place in the map ?
- how many links did they build between two or more concepts ?
- is the concept map mainly circular in shape or strictly hierarchical ?
- did the students understand correctly which are the more general concepts and the more particular ones ? And so on.

Moreover, a concept map holds certain main characteristics, irrespective to its field of interest:

- a focus question: "why is a robot different from a human being ?" Or "what is a robot ?"
- a central node: "my team robot" or "robotics"

The concept map should give a satisfying answer to first question and should start from the central/main node. The great advantage of concept maps over other frames of knowledge is that it is easily updatable over time. It can be reshaped during the activity, students can decide to add/delete node if the concept of a robot is changing (and it should) during the project and so on. This give a better insight to teachers into mental processes of creation/testing/reshape of knowledge of their students.

Part 2 – Tools and methodology

Concept maps can be drawn also by sheet and pen but a powerful tool is spreading in schools who decide to start the road of concept maps[4]. CmapTools is easy enough to be used also by children and nonetheless it provides all the range of tools needed to carefully following the mental evolution of concepts in students.
Students in our courses are asked to sketch a very preliminary concept map with this two characteristics highlighted before, as an example:

- a focus question: "why is a robot different from a human being ?"
- a central node: "a robot"

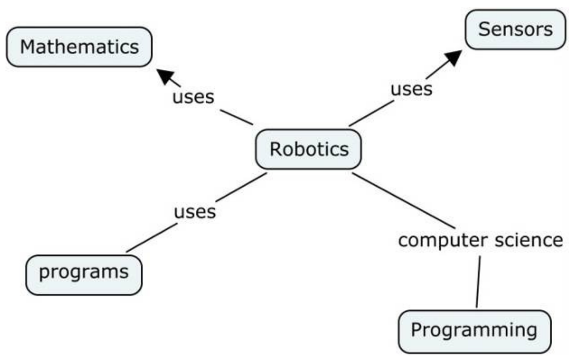
After that, students have to build the concept map with the knowledge they already have in their minds about robotics, irrespective to previous participations in robotics courses.
Hence, the author will periodically ask them to update their maps with new concepts and/or new links between concepts. Moreover, CmapTools allow easy expandability of maps also using external resources like photos, videos, web pages and so on. Students will be also asked to connect their conceptualization of robotics to other already existing way of conceptualizing this field, provided by expert in the field or, better, by other peer students. Finally, taking advantage of collaborative tools of the software used, they will be called to share their created resources with other students in the district or, broadely, over the Internet.

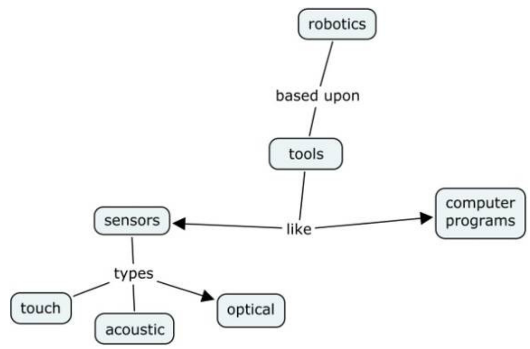
Part 3 – Preliminary results

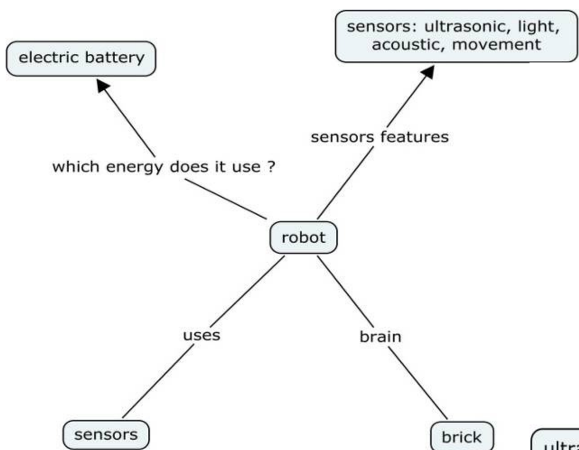
We report four concept maps, realized by students[5]. They have been created at the very beginning of the course and should provide an insight to what students think about robotics without prior good experimentation over this topic. The maps picked by the author highlight a good basic understading of what

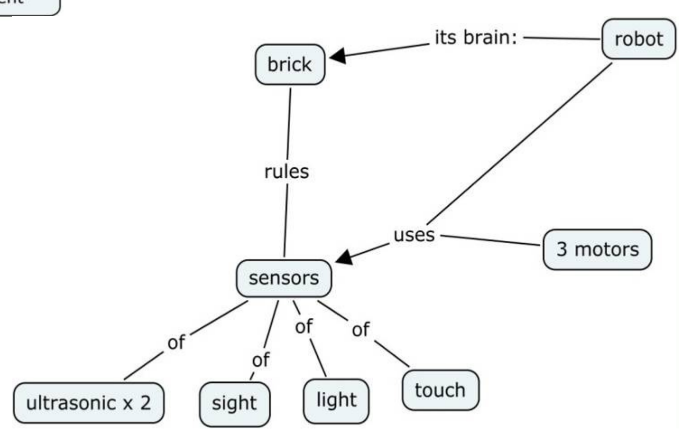
[3] See for example research in: J. D. Novak, A. J. Cañas, *The Theory underlying Concept Maps and How to Contruct and Use Them*, Technical Report IHMC Cmap Tools 2006-01 Rev 01-2008 and bibliography therein.
[4] Refer to: http://cmap.ihmc.us
[5] Maps reported here have been translated to english by the author. No concepts or links have been modified in any way.

a robot is and what can do and how it works.This knowledge may be derived from cinema and TV movies, books and of course the Internet. Another source of information may be a starting brief talk with the author, just at the beginning of the course.
The focus question of the map is: “what is robotics ?” and the central concept is, of course, “robotics”.
As you can see, one of the map is radial shaped and the other is more hierarchically shaped.
Throughout the course, the author will ask all the students to draw down again their maps, in order to improve them and see which new concepts and relations are added. Of course, the students will be also asked to compare their maps one another with their course mates.









5. Teams formation with different background students

First school
Part 1 – Goals
One of the two schools with ongoing projects have students with different backgrounds in robotics:
some of them have already participated to 2009 Lego courses and most of them are just at the beginning. The author decided to spread the older and more experienced participants throughout the teams, in order to charge them to work like a guide of the newcomers.

Part 2 – Methodology
All the groups decided to start a project from scratch on their own. This is better suited than last year projects, due to the presence of two experienced senior students, who can give their knowledge and practice to the newer ones. Of course, since the time of the course is strictly limited to 30 hours, there is a chance to leave the robot not completed. Anyway, the students showed a good originality in designing and foreseeing

new interesting robots, that may be useful to the surrounding they live in, both in classrooms and outside.
Part 3 – Preliminary results
At the time of writing this article, the outcomes are very different and may be divided in two categories, broadly speaking:

- guides who rule them all
- gently integrated leaders

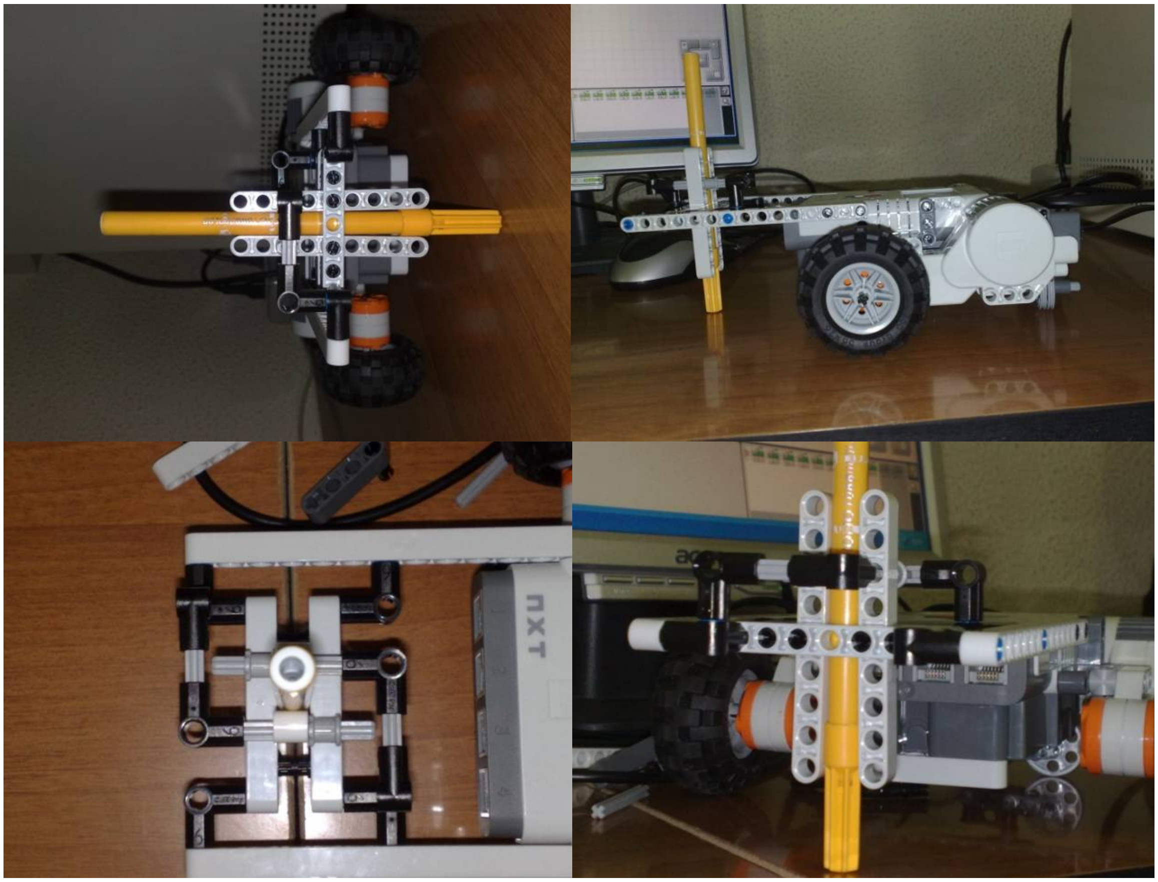
One of the students charged to guide the others belongs to the first set. He does not try to let his teammates driving conclusions on their own but simply accelerate the pace of construction and programming. He wants frequently to lead both programming and building and is overcoming the others, preventing their ability to learn more effectively. This arrangement will be changed as soon as possible during the course.
The other student is a girl who is collaborating more proficiently with her teammates (who are all males). She gives frequently only some hints to get to the conclusion of the task, both on the programming and on the building side of the project. The author thinks this group will work more effectively and the teammates will learn more and better.

Second school
Part 1 – Goals, methodology and preliminary results
The other school decided to divide strictly students in two parts, with respect to their previous experience in robotics. Hence we tried all the same to add new features to the courses, which are actually being tested and are listed here:

- english written robotics texts
- expansion over already created projects

The first characteristic is introduced since the Italian Ministry of Education is pushing further efforts to introduce deeper and deeper english as a second language in schools. Historically, the italian students have poorly proficied in this field. Now, it is going to be introduced in schools the possibiliy of teaching and learning a subject by speaking, writing and listening in english. That's why the author decided to provide english written texts to more experienced students in robotics. The students will not have italian–english dictionary to meerely translate words they do not understad. They will have to grasp the meaning of a word from the context it is placed in and from figures and schemes the authors provide in the books. This experimentation is actually ongoing and more results will be reported in future articles.

The second characteristic may be restated in this fancier way: “to give instructions or not to give instructions ? That's the question !”. What does it mean ? Last year, the author provided carefully written instructions to students, in order to build their robots. They simply had to follow the guides and will eventually get to perfectly built machines. But, of course, this is not what happens in real life, nor in robotics competitions or in other educational settings. This time, students will not be provided with goals and instructions to get to those goals but simply they will have, step–by–step, little goals to be gained throughout the project and no instructions at all. This is a higher risk in a strictly time scheduled course, but some good results have already been achieved:
one of the group had to build a support to hold a pen, for a drawing robot. The author decided not to give any instructions to the students and one of them autonomously started to think about a good tool to hold the pen. The first realization was not that suitable for the aim, since it let the pen move back and forth when the robot moved. So the student dismantled it and built it again from scratch. The result is very good and is reported in pictures below.



6. Future plans

The projects reported in this article are still ongoing at the time the author writes. Preliminary results are encouraging and the author thinks the route undertaken (and described herein) is well shaped to achieve remarkable learning goals. These projects will end next April/May 2010 and more thorough reports will be made available.

Acknowledgments

The author would like to thank principals, teachers, and administrative staffs of the schools involved, who supported the activity with great efforts and patience[6]:

- "S. Domenico Savio" Elementary and Middle School, S. Gregorio (CT) – Italy
- "G. Macherione" Middle School, Giarre (CT) – Italy

[6]Permissions for using pictures are granted from schools staff or directly to teachers involved in projects reported here.

Classroom Robotics for Future Elementary & Middle Level Teachers

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Introduction

The purpose of this paper is to describe a semester-long university course on classroom robotics I taught to future elementary and middle school teachers. I had become acquainted with classroom robotics from a middle school teacher who was enrolled in graduate courses at the university. Through this exposure I began to learn more about using and teaching with robots in the classroom. I had access to a university-purchased classroom set of LEGO Mindstorms NXT robot kits along with a few LEGO WeDo robot kits to use with the students. I developed this "topics" course to introduce classroom robotics to the future teachers in our education program.

The 34 students in the course met weekly for 2½ hours during the 15-week semester. Class time was split among in-class activities and discussion, mini-lectures on specific topics, and small group programming or building projects. Most of the students were in their third or fourth year of a four-year teacher education program. They were all preparing to be teachers in grades K-8. None of the students had previous experience with classroom robots and very few had ever taken a course in computer programming. There were three broad goals for student in the course: (1) Learn how to build and program robots, (2) understand appropriate pedagogy when using robots in the classroom, and (3) explore ways robots can be integrated into lessons for K-8 students.

Learning about Robots

On the first day of class the students inventoried their Mindstorms kit. This allowed them to get familiar with the pieces they had available. Then they began to build their first robot – a basic build with two motors and places to attach sensors. In the second week, students learned to make their robots move with the basic NXT-G programming blocks. These blocks were introduced in "programming chats" led by the instructor and then students engaged in small challenges using these programming blocks (e.g., make the robot maneuver around your chair, program the robot to trace a figure-eight). There seemed to be a strong sense of accomplishment among the students as they put together the programming blocks and worked on debugging their programs until they were satisfied with the results.

Over the next few weekly class meetings, several sensors (touch, ultrasonic, sound, light) were introduced and the programming options were expanded to include loops, waits, and switches. After eight class meetings students had become familiar with all of the blocks of the NXT-G common palate. They had worked through several activities in Classroom Activities for the Busy Teacher: NXT (Kee, 2008a) and had completed a small project of their own where they programmed their robot to do several actions using the various blocks and sensors. In addition to learning about programming the Mindstorms robot, students become familiar with resources (e.g., Kee, 2008a) available to them when they become classroom teachers.

To provide the students with additional experience in building robots in the second half of the course, we turned to The Mayan Adventure (Kelly, 2006), a theme set of building and programming tasks. Students were organized into small groups with each getting a segment of the story line and the corresponding task. I did not provide students with the building and programming suggestions from the book. Instead, two groups of students were assigned to each task and competing ideas were generated for solving the tasks proposed by the fictitious archaeological team in the book. This project gave the students experience working through various engineering design and robot programming issues. Groups shared their ideas to improve their

designs and become more successful at each task.
By this time in the course students were quite familiar with all of the blocks in the NXT-G common palette. I wanted them to also know about the additional programming options available in the complete palette. Drawing from the NXT-G Programming Guide (Kelly, 2007), The LEGO Mindstorms NXT Zoo! (Rhodes, 2008), and the nxtprograms.com website, students studied programs written by others and worked to understand the additional features available on the complete palette. At times I wrote programs using recently introduced blocks (e.g., random, logic, math, text to number) and wires and asked students to figure out what they would do if run on a particular robot. My intent was for students to be comfortable reading NXT-G programs written and knowing how to debug those programs even though they did not have time for them to become expert in using these blocks to write their own programs.

During the final weeks of the course, students gained experienced with the datalogging capabilities of the Mindstorms NXT system by completing activities from Datalogging for the Busy Teacher (Kee, 2008b). They encountered ideas of measurement and data analysis while exploring these experiments.

Pedagogy with Classroom Robots
While students were learning to program and build the robots, I used appropriate pedagogy to support their developement. This was the same teaching explicitly discussed each week during time spent focused on pedagogical issues. Our discussions were framed from reading Blocks to Robots (Bers, 2008). One of the significant aspects we discussed was the philosophy of constructionism (Papert, 1980/1993). Bers identifies four basic tenets of constructionism: (1) Learning by design, (2) Objects to think with, (3) Powerful ideas, and (4) Thinking about thinking (p. 16).

Constructionism proposes that students learn better when they have opportunities to design, create, and build projects that are meaningful to them. As they build their projects, the objects they build become important tools that can, in turn, shape their thinking. As their thinking develops, they build "powerful ideas" that are part of the knowledge and processes of a discipline. Finally, learning experiences are better when students have opportunities to reflect on their thinking and make it visible to the community. During the course students had several opportunities to create projects that were meaningful to them. I provided some guidelines but kept things open for students to engage with the project in their own creative way. Some students were more audacious while others fulfilled requirements without excess flourish. Each assigned project was designed around one or more "powerful ideas" and students always had opportunities to reflect and share their thinking through programming chats, technology circles – where students would stop working and share the progress and problems they had on their projects (Bers, 2008), or written reflections.

Several classroom issues were discussed with other readings from Bers (2008). For example, structuring the classroom with programming, building, and design stations was encouraging to the future teachers as they thought about teaching with robots, something still new to them. They also found it helpful to read accounts of teachers of young students who were using robotics in their classrooms. From experiencing an appropriate pedagogy as students learning about robots to reading and thinking about it as future teachers, I felt students were better able to integrate their developing understanding.

Robotics Lessons for K-8 Students

The assigned readings and in-class discussions of pedagogy did much to connect students' learning from the class with their future work in the K-8 classroom. A major assignment also served to tie together students' knowledge of robot building and programming with their knowledge of teaching younger students with robotics. The students worked alone or in small groups to create a classroom lesson (or set of lessons) that incorporated a robot. (See Table 1 for descriptions of selected lessons designed by the students.)

The various lessons drew from several content disciplines but each was required to incorporate a "powerful idea" from that discipline. Some students chose to focus on engineering ideas such as robot building and design. Others drew on ideas in computer science such as programming, loops, or logic while others chose to emphasize ideas from mathematics or science such as data collection, motion and rate, or gears. Storytelling and sequencing were some of the ideas with connections to language arts. In addition to having a "powerful idea," students also had to design their lessons around constructionist principles. The students drew on what they knew to create learning environments and activities that would encourage and support learning.

After the groups completed their lesson plans and built their robots, they demonstrated them to their classmates. Each group was eager to see the work of others and several lesson plans were shared among the students. The students also presented their projects at an exhibition for a broader audience of future elementary and middle school teachers. This event seemed to generate excitement about the prospects of using robots in the classroom.

Reflections on the Course

Overall, I felt the course was successful. Since I was fairly new to using robots I learned many things along with the students. I never hesitated to say, "I don't know; let's figure it out." On several occasions students taught me alternate ways to program or build a robot.

I was surprised at how enthusiastic students were about robotics by the end of the course. To begin, I noted some were hesitant because they had no experience with robots or programming. By the start of the start of the third class everyone was engaged and eager to experiment with the robots. Students did experience frustration during some projects. They were generally able to manage their frustration by taking a break and reflecting on the problem, talking about their specific issues in a technology circle, or modifying their design or program to avoid the problem.

Several students expressed a concern about teaching with robots: How can a resource-limited classroom teacher get robotics kits? We discussed ways a teacher might be able to use one or two robots with her students, rotating the opportunities through the class. Alternately, I shared some sources that could provide grants for purchasing robots. One member of the class was a mother of an elementary school student and she worked with a school administrator to acquire robots for her child's school. I also let the students know that universities such as ours are able to cooperate and share robotics kits with elementary and middle school teachers.

By the end of the course several of the future teachers were eager to continue their involvement with classroom robotics before they graduated. As a next step for our university, we are organizing after-school and summer robotics workshops for middle school students to get them involved in building and programming robots. We are also working to connect some of the future teachers, who now have experience with robots class, with area teachers who use robots in their classrooms. Hopefully these experiences will leave positive impressions on the future teachers so that they will seek opportunities to use classroom robots with their students in the future.

Future elementary school teachers present a lesson using a robot spider

Resources & References

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Table 1: Descriptions of Selected Student-Made Lessons

Grade	Title	Powerful Idea
Grade 3	Robot, Robot, What Do You….	Sequencing/programming, using symbols to communicate a message, senses
	This unit is designed for use with two children's books: "Polar Bear, Polar Bear, What Do You Hear?" and "Brown Bear, Brown Bear, What Do You See?" Students learn how to program the NXT Robot to perform different actions when it encounters various levels of sound or light. Students test objects to see if the robot can sense them. Students also make a book, "Robot, Robot, What Do You See and Hear?" Students use their creativity and imagination when writing their story. Students make a flowchart showing what the robot does when it encounters different objects or light.	
Grade 3	Number Line Robot	Number sequencing, number relationships.
	The students use touch sensors on the front and back of the robot to make it move forward and backward along a number line. During several lessons, the students learn how to achieve forward movement (positive), extend this to backward movement (negative), and then apply this knowledge to forward and backward movement along the number line. Students visualize the concepts of number sequence and number relationships. To conclude, students are presented with a scenario: The robot is a pizza delivery person and must start at the pizzeria (0 on the number line) and deliver pizzas to three houses (indicated by numbers that correspond to numbers drawn from a stack of cards) and then return to the pizzeria.	
Grades 1-2	What a Croc!	Habitat
	The class begins by brainstorming for a story about an animal. The animal is built with the WeDo kit. The story must include actions the robot can be programmed to do. In the next class days, students rotate among several stations: story writing, building, programming, and brainstorming for a diorama. The diorama must show an accurate example of the habitat the animal naturally lives in. On the last day the students invite family and/or classmates to see their exhibits, and hear their stories. They read their stories, explain their habitats, and describe and demonstrate their animal.	
Grade 6	Snowmobiles	Gears
	Students work in groups to create two different robotic snowmobiles. Students test their snowmobiles to see which one is the fastest. After testing their snowmobiles, students modify their snowmobiles in order to allow the slow snowmobile to move faster. The students learn about gears when finding out how to make their slow snowmobile faster. To finish, students have to equip their snowmobiles with a sensor to improve safety in the dark.	

The Buzz of Robotixlab Experiential Workshop…

Antony Kanouras
Robotics Engineer MSc, MIET

“Good evening everybody! Form seven teams, think of a name for your team and the competition “Green Robot” shall shortly begin”

The very first minutes some positive confusion prevails. Enthusiasm arises, energy, agony for the new challenge and a feeling for noble rivalry and competition. The teams are formed, inventive team names are made up and everything is ready for another 2 hours long experiential workshop into the magical world of robotics and technology.

“Very well, today’s challenge titled “Green Robot” is themed after ecology and the environment. The aim and objective of each team is to build and program via the PC a robot that is able to navigate around and stop in front of every “piece of garbage”, simulated by either a red or blue ball. The robot should use its sensors to detect and classify the color of the ball and take a decision. Red balls are not recyclable garbage and should be kicked out of the field, while blue balls can be recycled and should be left in the field.”

Whispers and lots of mobility prove the surprise, the curiosity, and the exchange of opinions and ideas. The fermentation of all these produce knowledge through creativity and experimentation. Learning that comes from the inside, based on the personal stimuli.

The buzz turns into absolute silence when the rules of competition are announced and the presentation of the essential theory begins. "Each team starts with 10 points. For each part of competition that you solve, your team gains some points. For each "act of misbehaving", your team loses 5 points." A new sensor, the ultrasonic one for the measurement of distance, its principal of operation and how to practically use it is added in the knowledge of children through a game of questions and answers. The information is extracted by them and is enriched with more properties from the presentation of the teacher. The new information is multidimensional and it‘s supported by video documentaries and live demonstrations.

During the first phase of the workshop the teams have to answer some questions based on the subject of the challenge, the theory and the video documentary that was presented. "For every right answer you get 2 points, and for the question about the algorithm I want the answer in a flow chart form. As soon as you submit your answers, you begin building the robot." The written part of the challenge promotes critical thinking and asks for problem solving and brainstorming techniques as they were presented in the introductive courses.

The pens “are on fire” as the next phase is the most creative one while unique skills and dexterities are developed through “playing”. About 500 elements like wheels, motors, gears, beams, axles, bricks, little lamps, small speaker, cables, microcontroller, sound sensors, light sensor, distance sensor, touch sensors and more, are the materials that every team of small inventors is equipped with to build their robot. They have to cooperate and work methodically. The time pressure and the competitive environment increase their productivity.

“Have a short break to announce the results of the written part of the competition. The team with the most

right answers and the 10 points of that phase is the Mechanical Sticks! Give them a round of applause! The points of the rest are on the board."
After a short open discussion about the right answers the teams are back on track with the robot's implementation. At this point they experiment a lot by trying in practice various ideas and get the chance to discover knowledge and deeply understand the theory.

"As I can see you are all done with your robots, please move into the PC lab, connect your robots to the USB port and start programming by following tutorial 21. The first team that its robot demonstrates the proper behavior gets 10 points. Every next team that finishes successfully gets the points of the previous team minus 2."

It's time for the teams to orchestrate everything. The robots are ready, fully equipped with sensors, motors, wheels and waiting instructions. The educational programming environment is specially designed for young students and introduces programming in a friendly way. Instead of using text based programming, icons based programming is used in a flow chart fashion. The program is downloaded to the robot's brain and then the robot is disconnected from the PC and it is fully autonomous to act in space.

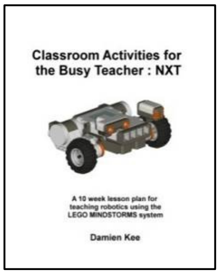
Following a tutorial first, the teams are introduced in a step by step way to the logic of programming. Then they are asked to program their robots once more but the task this time is original and there is no tutorial related to help them.

"Green Robots, in the arena! Let the games begin!" After the "GO" signal the robots start cleaning the arena. For every non-recyclable garbage they kick out of the field they get some points. Everybody is in great spirits and adrenalin gets to the max. "The wizards of Golf are ahead while the rest are following close. The blue bananas team is back on track and the Mechanical Stick run and kicks another red ball out of the field and Driiiiiiiiiinnnn!"
The bell indicates the end of one more Robotix Lab Workshop, the final scores are announced and the winners get the rest's applause and gratitude while everybody renews the meeting for next week.

In the magic world of Robotix Lab Workshop, the creation, the knowledge, the development of interpersonal skills and the hands on experience is the reflection of the kid's efforts and their personal reward at the same time. Along the same philosophy, there is no right or wrong opinion or idea and everybody is encouraged to participate and help their team. Most inventions evolved through a "mistake" anyway!
The experiential Robotics and Technology Workshop is organized and run by Robotix Lab, in Thessaloniki, Greece and presented to the participants by Antony Kanouras, Robotics Engineer with expertise into educational robotics. The structure, the material and the final form of the workshop is tailor made to the requirements and the educational philosophy of each educational establishment from the specialists team of Robotix Lab (www.robotixlab.com).

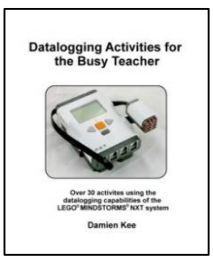
Teacher Resource Books

Classroom Activities for the Busy Teacher: NXT
This book outlines a 10 week set of lesson plans for teacher wishing to implement robotics in their classroom. A set of robotics challenges are presented, centered around the LEGO NXT MINDSTORMS system. The workbook includes 10 robotic based challenges as well as 3 additional modules with assessment activities covering Robots in Society, Flowcharting and Multimedia Presentations.



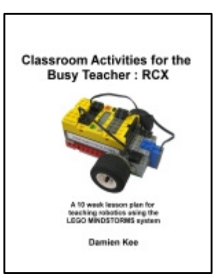
Each module includes:
- A real world scenario
- Theory of the concepts presented
- Teachers notes outlining common issues and how to solve them.
- Example Programs in the NXT-G development environment
- Extension activities
- Student worksheets

Datalogging Activities for the Busy Teacher: NXT
This book provides over 25 different datalogging activities that can be easily implemented in class. It utilises the new NXT-G 2.0 software to quickly and easily configure experiments, and display the results. Each experiment comes with teacher notes, sample graphs and student worksheets.



Experiments are provided for the following sensors:
- Touch Sensor
- Sound Sensor
- Light Sensor
- Distance Sensor
- Rotation Sensor
- Temperature Sensor

Classroom Activities for the Busy Teacher: RCX
This book outlines a 10 week set of lesson plans for teachers wishing to implement robotics in their classroom. A set of robotics challenges are presented, centered around the LEGO RCX MINDSTORMS system. The workbook includes 9 robotic based challenges as well as 3 additional modules with assessment activities covering Robots in Society, Flowcharting and Multimedia Presentations.



Each module includes:
- A real world scenario
- Theory of the concepts presented
- Teachers notes outlining common issues and how to solve them
- Example Programs in the RoboLab development environment
- Extension activities
- Student worksheets

www.theNXTclassroom.com