Macquarie ICT Innovations Centre

Robotics 3.0

Project Report 2011

Sue Fennell
Debbie Evans

Macquarie ICT Innovations Centre

MACQUARIE UNIVERSITY

NSW GOVERNMENT Education & Communities

Macquarie ICT Innovations Centre is a collaboration between the NSW Department of Education and Communities and Macquarie University

About this report

Project team

Project Leader
Sue Fennell
Macquarie ICT Innovations Centre

Centre Director
Debbie Evans
Macquarie ICT Innovations Centre

Schools involved

Iteration 3.1 – Bee-bots
Auburn North PS
Auburn PS
Burraga PS
Curran PS
Gymea Bay PS
Kambora PS
Lindfield East PS
Quakers Hill PS
Turramurra North PS
Westmead PS

Iteration 3.1 – Pro-bots
Jewells PS
North Ryde PS
Terrey Hills PS

Iteration 3.2 – Bee-bots
Birrong PS
Castle Cove PS
Wahroonga PS

Iteration 3.2 – Pro-bots
Wahroonga PS

Table of contents

Executive Summary

About the Centre

The Macquarie ICT Innovations Centre (MacICT) is located at Macquarie University, Sydney, Australia. It is a collaborative agreement between Macquarie University and the NSW Department of Education and Communities (NSWDEC). The centre provides the opportunity for all K-12 schools to access innovative technologies in teaching and learning.

The Centre's focus reflects an innovative project-based approach to working with K-12 teachers and their students. The Centre's core business includes a comprehensive teacher professional learning and support program. MacICT staff, academic research partners from Macquarie University and school teachers collaboratively develop projects that utilise the most innovative, emerging technologies in education.

MacICT is also able to develop and implement small proof of concept projects to evaluate the use of new technologies quickly, providing feedback to our partners about the resource demands of scalability, for example.

MacICT is also able to connect and collaborate with other educational institutions and industry partners to inform the education community and provide significant research knowledge about the capacity of new technologies to enhance student learning.

Mission Statement

'to develop, implement and evaluate innovative ways of enhancing learning through the application of dynamic and emerging information and communication technologies'

To find out more please visit our website at **www.macict.edu.au** and our blog at **http://web2.macquarieict.schools.nsw.edu.au**

Industry Partners

Microsoft Be what's next.

lenovo FOR THOSE WHO DO.

Moore Educational - supplier of serious fun -

imi INTERACTIVE MEDIA INSTITUTE

Panasonic

Studio of Applied Arts & Sciences

SANYO AUSTRALIA

MCV PACIFIC THE MARKET FOR COMPUTER & VIDEO GAMES

ELECTROBOARD Celebrating 25 Years Leaders in Innovative Education Solutions

DEHub Innovation in Distance Education

UBISOFT

mindscape

RM Education Inspiring Engaging Learning

THE UNIVERSITY OF SYDNEY SYDNEY COLLEGE OF THE ARTS

MTA Modern Teaching Aids National Distributor of LEGO® Education

TURTLE BEACH

FLL FIRST LEGO® League

EDUCATION TECHNOLOGY SPECIALISTS

Strategy: Early Years Strategy, Middle Years Strategy
Syllabus Addressed: English, Mathematics, all other KLAs
State Priority Area: Connected Learning, Teacher Quality
NSR Priority Area: To foster and lead differentiated learning

Technology Requirements: Participating schools need a programmable floor robot – Bee-Bot, Constructa-Bot or Pro-Bot. Evidence indicates that a collection of 6 Bee-Bots is adequate to start and that teachers consider a ratio of 1 Bee-Bot to 2 students is optimal.

Project Rationale

In 2011 the Roboitics Project operated in three formats:

1. Robots in the Classroom Project

Teacher and student sharing of learning experiences through the blog and formal and informal video conferences gave real-world meaning and context to use of the robotic toys in Iterations 1-2 of this project in 2010. What we now know is that students are excited and engaged by robotic toys in their classrooms, demonstrate verbal and written skills in sharing toys, negotiate activity solutions and report on their findings and are excited to use video conferences between schools to share their learning.

We also know that teachers seek and value professional development to support classroom practice and quickly and confidently adopted and adapted ideas shared through the 2010 professional learning network (PLN) using the blog or video conferences. Teachers valued robotic toys as a tool for engaging students in multiliteracies in cross-curriculum contexts, valued the creation of a repository of teaching and learning resources and recognised the need to link NSW Quality Teaching Framework to their classroom practice.

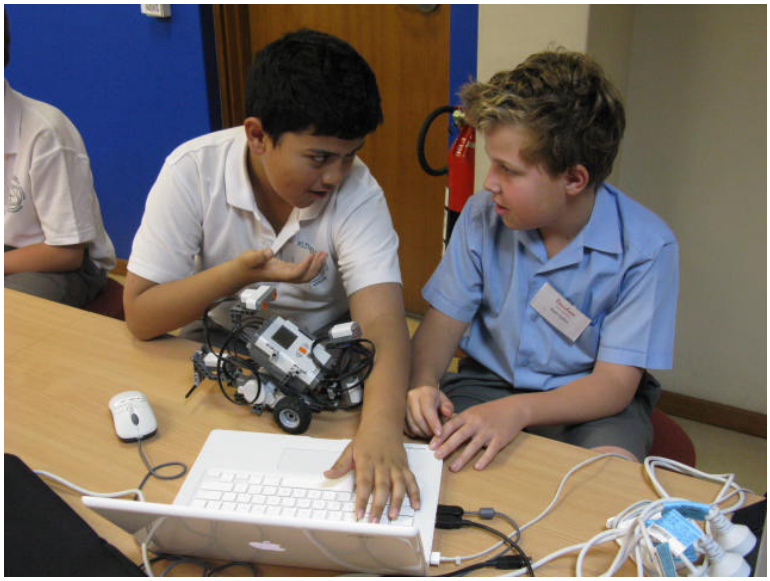
This project aims to establish a collaborative, open-ended online Professional Learning Network (PLN) which fosters the sharing of practice using robotic toys in the K-2 classroom and better understand how emerging technologies support pedagogical skills and collegial engagement of teachers while using simple robotic toys. This project was designed to facilitate classroom adoption of Bee-Bot technology, promote the purposeful use of various technologies and investigate the role of online collegial support between teachers using a blog and Connected Classrooms. For pragmatic reasons, this project was designed to run over a 10-week period.

2. Special Events

Some schools were unable to commit to a longer-term project but were keen to participate in robotics events. Such events included the LEGO Challenge Day in August and the So You Think Your robot Can Dance (SYTYRCD) Robot Boot Camps and World Record Event held in October as part of the 3dedrats festival (see separate report).

3. Gifted and Talented Enrichment Program

These workshops run both at MacICT and in school were developed to cater to the needs of Gifted and Talented students (GATS).



	Schools	Teachers	Students	Regions
Robotics Project 3.1	13	28	540	6
Robotics Project 3.2	4	15	250	2
LEGO Robotics Challenge	16	16	128	9
SYTYRCD Guinness Record	8	13	215	4
SYTYRCD Workshops	7	11	158	4
Total	**48**	**83**	**1291**	**25**

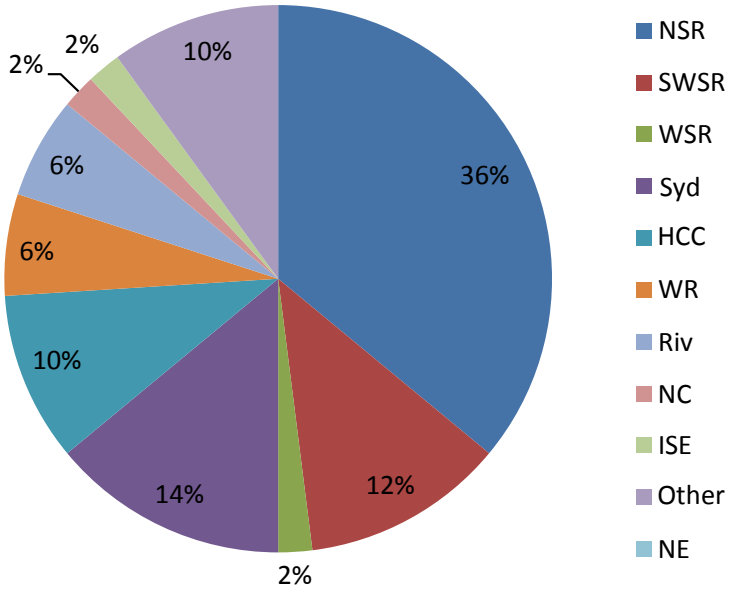


Fig 1. Participation in Robotics Project Activities 2011

To find out more about this project please visit our website at **http://www.macict.edu.au/index.php/projects/menurobotics.html**

For current progress with the Bee-Bot Robots, please visit our blog at **http://web2.macquarieict.schools.nsw.edu.au/01001**

For current progress with the Pro-Bot Robots, please visit our blog at **http://web2.macquarieict.schools.nsw.edu.au/09001**

Strategic Focus

This project links to the MacICT Strategic Plan 2011 in elements 1.1, 1.2, 1.3, 1.5, 2.1, 2.2, 2.3, 3.1, 3.2, 3.3, 3.4, 3.5, 4.2, 4.3, 4.5 *(please see Appendix A).*

Conclusions from 2010

Teachers and students value robotic toys in the classroom learning program. Students reported enjoyment, excitement and a desire to use the robotic toys in their classrooms. Teachers recognised an engaging integration of technology in their classrooms. They adopted and adapted teaching and learning resources shared amongst the Professional Learning Network. They recognised that benefits included higher-order thinking and problem solving by students. Principals recognised the student and teacher excitement, saw a positive impact from Bee-Bots in the classrooms, were happy to recommend the adoption of Bee-Bots as a learning tool and expressed interest in an extending the project to incorporate robots suitable for older students.

By the end of December, 2010 the 2010 Bee-Bot blog ***http://myBee-Bot.wordpress.com*** had received 5740 views. The high number of viewings of the 2010 blog indicated that teachers appreciated the resource repository available, especially MacICT designed teaching and learning resources located on the blog. Teachers generally preferred to view rather than post to the blog. In short, the robotic toy was quickly integrated into classrooms, but the value of sharing on the blog seemed to be less certain.

Implications for 2011

Based on the conclusions from 2010, the Bee-Bot Project continued and offered an extended participation to all NSW DEC schools in 2011.

Participation in Iteration 3.1 was open to teachers of Kindergarten to Year 3 who had Bee-Bots and Pro-Bots. Responding to requests from NSR principals, Iteration 3.2 was prepared to extend the PLN into middle schools by establishing a Stage 2 and 3 Robotics Project. This iteration supported Bee-Bots, Constructa-Bots, Pro-Bots, Lego NXTs and ED-E.

Recognition of the time-poor situation all teachers reported in 2010 led to a “lower key” approach in 2011. Teachers’ evaluation, using MyPL@DET includes questions about:

- **The variation in student ability and confidence to become self-directed learners.** Does this reflect teacher inexperience, a conscious decision to maintain a teacher-directed classroom or poor survey construction?

- **The development of resilience in students using robotic toys in the classroom teaching and learning program.** Does this transfer into other learning situations?

- **The effectiveness of private online communities to foster and support a**

Professional Learning Network. Is BlogED the tool for 2011? Should the blog remain open to the world? Is the global audience valuable? Can interstate and international connections be created, enhanced or continued? Is Yammer Bee-Bot community an appropriate tool?

• **The Key Learning Areas in which students use robotic toys in the classroom teaching and learning program effectively.** Can we identify and promote best practice? Is the blog the tool for sharing best practice?

Project Objective

In 2011, the project will be identifying "best-fit" appropriateness of all available educational robots eg. Bee-Bot, Constructa-Bot, Pro-Bot, Lego NXT for identified learning contexts by extending the project into middle years. This investigation will allow for greater differentiation of learning for all students involved by providing access for all students K-12 to robotic technologies while fostering a wider professional learning network.

Student Direction

Students exercise some direction over the selection of activities related to their learning and the means and manner by which these activities will be done. Teachers are encouraged to enable students to lead the learning of their peers by guiding others and suggesting activities for others to attempt.

Tasks are designed so that students exercise some direction over the selection of activities related to their learning and the means and manner by which these tasks will be done. Again the early stages of students participating limited their options in producing written evidence. Some students attempt drawn evidence. Few schools had recording equipment suitable for use by students, thus there is minimal evidence acquired by the students themselves.

Social Support
There is strong positive support for learning and mutual respect among teachers and students and others assisting students' learning. Teachers are encouraged to establish classroom environments which are free of negative personal comment or put-downs.

What does it look like in assessment tasks? As yet, it is not readily observable in written tasks, but may be observable in performance-based tasks as it would be in the classroom. Students are often at the pre-literacy stage of development. Some are gaining independence in reading and writing. From these students evidence might be in the form of "Fred and I did ...." Teachers are encouraged to use digital stills and video cameras to capture evidence of student use of the robots. This evidence may be shared by posting on the project blog.

Students' Self-Regulation
Teachers consistently report that the level of motivation and engagement of students is very high. Students demonstrate autonomy and initiative so that

minimal attention to the disciplining and regulation of student behaviour is required.

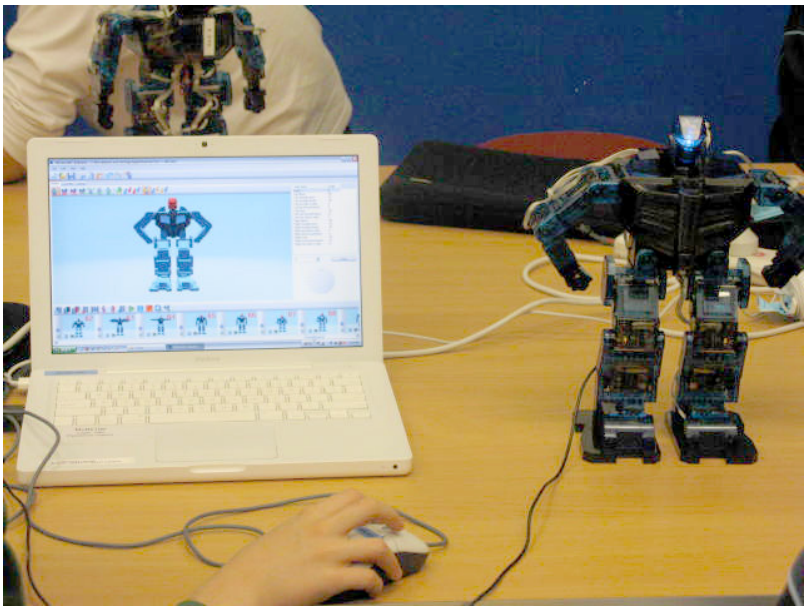
What does it look like in assessment tasks? As yet, this is not readily observable in most written or drawn tasks, although recorded images and video that are captured by teachers provide the best evidence.

Teacher Professional Learning

This project has been registered with the NSW Institute of Teachers and provides teachers with 17 hours of accreditation at professional competence level and will address the following Professional Teaching Standards: 2.2.3, 3.2.6, 4.2.5, 5.2.3, 6.2.1, 7.2.4.

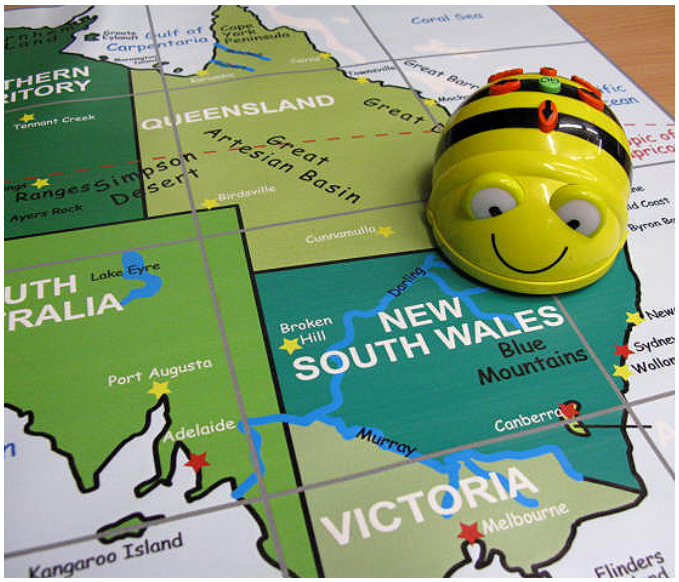
Teachers participating in this project register for professional learning (PD) through MyPL@DET. MacICT provides 2 full days of PD. Teachers first learn about the robot and the supporting software. They are then trained in using the specified robot in the classroom. Teachers investigate the opportunities to integrate the robot across all Key Learning Areas (KLAs) and identify elements of the Quality Teaching Framework *(see Appendix B)* which are supported by the integration of robots in the classroom. The second day of PD is 'Bots and Blogs'. During this PD teachers are introduced to a variety of Web 2.0 tools, the vaidity of blogging by students, copyright, social media, social networking tools, using digital and video cameras and the process of posting and adding media to MacICT's Robot blogs.

Element 2	**TEACHERS KNOW THEIR STUDENTS AND HOW THEY LEARN**
Knowledge of students' varied approaches to learning	2.2.3 Apply practical and theoretical knowledge and understanding of the different approaches to learning to enhance student outcomes.
Element 3	**TEACHERS PLAN, ASSESS AND REPORT FOR EFFECTIVE LEARNING**
Selection, development and use of materials and resources	3.2.4 Use resources and materials that engage students and support their learning.
Linking assessment to learning	3.2.5 Use effective strategies to assess student achievement of learning outcomes.
Element 4	**TEACHERS CREATE AND MAINTAIN SAFE AND CHALLENGING LEARNING ENVIRONMENTS THROUGH THE USE OF CLASSROOM MANAGEMENT SKILLS**
Teaching strategies	4.2.5 Create, select and use a variety of appropriate teaching strategies and resources including ICT and other technologies to make content meaningful to students.
Element 5	**TEACHERS CREATE AND MAINTAIN SAFE AND CHALLENGING LEARNING ENVIRONMENTS THROUGH THE USE OF CLASSROOM MANAGEMENT SKILLS**
Establish a climate where learning is valued and students' ideas are respected	5.2.3 Implement strategies to establish a positive environment supporting student effort and learning.
Element 6	**TEACHERS CONTINUALLY IMPROVE THEIR PROFESSIONAL KNOWLEDGE AND PRACTICE**
Capacity to analyse and reflect on practice	6.2.1 Reflect critically on teaching and learning practice to enhance student learning outcomes.
Element 7	**TEACHERS ARE ACTIVELY ENGAGED MEMBERS OF THEIR PROFESSIONS AND THE WIDER COMMUNITY**
Contributing to the school and wider community	7.2.4 Interact and network with colleagues and community stakeholders in educational forums.



Project Activities

NAME OF ACTIVITY	TYPE OF ACTIVITY	NO. OF HRS	MY PL@DET COURSE CODE	COST (INCL GST)	PARTICIPANTS
Robotics Project	Project	17	151NSR	$55	Project Teachers
Bee-Bots & Constructa-Bots F2f Workshop	Workshop	5	151NSR075	$110	All Teachers
Pro-Bots F2f Workshop	Workshop	5	151NSR07	$110	All Teachers
Lego NXT-G F2f Workshop	Workshop	5	151NSR075	$110	All Teachers
ED-E F2f Workshop	Workshop	5	151NSR075	$110	All Teachers
'Bots & Blogs F2f Workshop	Workshop	5	DV00966	$110	All Teachers
VC – BBs & CBs	Project Showcase	1	DV01047	Nil	Teachers and Students
VC - PBs	Project Showcase	1	DV01063	Nil	Teachers and Students
Support VC	Video Conference	1	DV010	Nil	Project Teachers
Information VC	Video Conference	1	DV00379	Nil	Project Teachers
Student Training at MacICT	Student Workshop	5	N/A	$10 per student	Project Students
In School Student Training	Student Workshop	5	N/A	$330	Project Students



Iteration 3.1 - Robots in the Classroom

Description

This project aims to establish a collaborative, **open-ended online Professional Learning Network (PLN)** which fosters the sharing of practice using robotic toys in the K-3 classroom and better understand how emerging technologies support pedagogical skills and collegial engagement of teachers while using simple robotic toy**s.** This project was designed to facilitate classroom adoption of robotic technology, promote the purposeful use of various technologies and investigate the role of online collegial support between teachers using blogs and video conferencing.

Teachers participating in the Robots in the Classroom project registered for professional learning (PD) through MyPL@DEC. MacICT provided two full days of PD for project participants. The first day trained teachers in using the Robots in the Classroom. Teachers learned about their nominated robot and the supporting software. As well, teachers investigated opportunities to integrate the robot across all Key Learning Areas (KLAs). Teachers identified elements of the Quality Teaching Framework (QTF) which were supported by the integration of robots in the classroom.

The second day of PD, 'Bots and Blogs, introduced teachers to a variety of Web 2.0 tools, the validity of blogging by students, copyright, social media, social networking tools, using digital and video cameras and the process of posting and adding media to MacICT's Robot blogs.

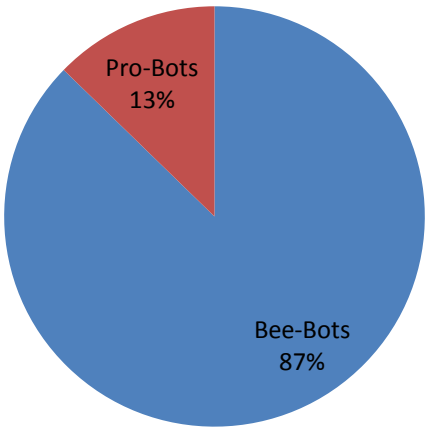


Fig 2. Type of Robots used by participants

Participation Data

Schools Involved

Auburn North PS
Auburn PS
Burraga PS
Curran PS
Gymea Bay PS
Jewells PS
Kambora PS
Lindfield East PS
North Ryde PS
Quakers Hill PS
Terrey Hills PS
Turramurra North PS
Westmead PS
Castle Cove PS
Birrong PS
Wahroonga PS
Beauty Point PS

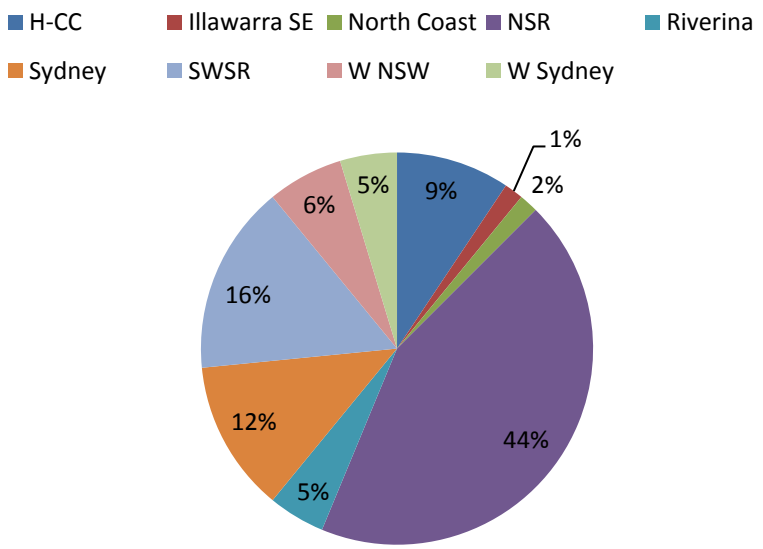
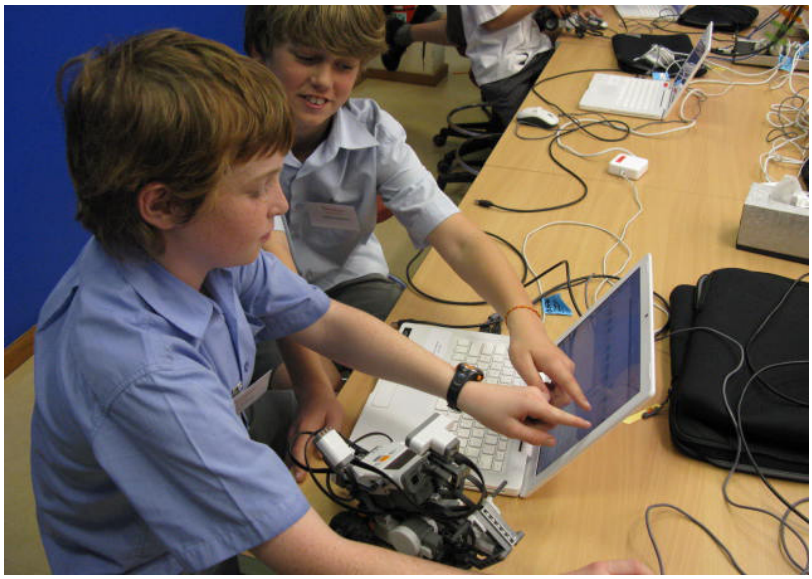


Fig 3. Project participants by region



Findings

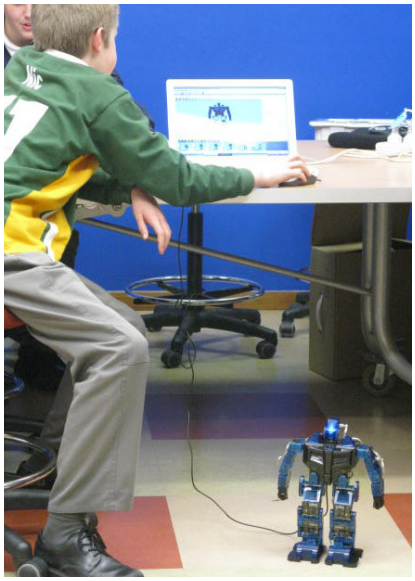
- Seventeen schools committed to the project, with a total of 46 teachers formally registered. 52% fulfilled their commitment to the project.
- 33% of teachers were seeking recognition as part of the New South Wales Institute of Teaching (NSWIT) accreditation. 58% of these fulfilled their commitment to the project.
- 38% of respondents reported having Bee-Bots in their school, 4% reported having Pro-Bots and 20% reported having both Bee-Bots and Pro-Bots in their school.
- Two professional conferences invited presentations about the Robots in the Classroom project.
- Five teachers were willing to share significant resources with Conference participants.

Curriculum

- Feedback from students, teachers and principals indicated that the purchase of Bee-Bots and/or Pro-Bots was cost effective with improved outcomes for students recognised.
- Schools with LEGO NXT robots were mostly using these robots in specialist (and often parent-funded) extension groups only and none had a program whereby the robots were used as part of the normal classroom teaching and learning. No schools made contact about using Ed-E, humanoid robot before participation closed for 2011.
- Teachers used robots to consolidate literacy (46%) and mathematics (58%) most often, but not exclusively. Only Creative and Performing Arts were not explicitly noted. 21St Century skills of teamwork, negotiating and problem-solving were also recognized.
- Teachers believed that robots engaged and excited students to become active learners.
- 87.5% of respondents rated the use of ICT in the classroom to meet syllabus outcomes as 4/5 or 5/5 on the Likert scale.
- 96% rated the use of appropriate teaching strategies and resource as 4/5 or 5/5 on the Likert scale.

Technology

- Programmable robotic floor toys provide valuable technological integration for classroom teaching and learning across all Key learning Areas.
- The commitment to blog was difficult for time-poor teachers. Blogging was undertaken by 50% of teachers registered with the project. Teachers posted brief explanations of their students' activities and their professional observations.
- Teachers valued the access to the extensive resource repository and were happy to access a private blog (Edmodo).
- Conversations between participants in Edmodo were sparse. The nature of these conversations was informal but professional.



- Social media opportunities were used with Twitter and a Maang (DEC micro-blog) group (Bee-Bots in the Classroom) was created for project participants.
- School's committed to the project readily, however they delayed purchasing the robots, a minimum project requirement. This delay imposed a restricted time period on the teachers, and impacted by increasing their workload.
- Video conferences were undertaken for the firest time in some schools. During PD sessions, teachers were counseled to be vigilant about cybersafety issues when blogging. They were reminded of the public nature of the blog and the need to ensure that individual student identification was restricted. Most teachers had nil or minimal experience of blogging and the warnings appeared to initiate inexperienced teachers' anxiety (as communicated during the PD) about risk to students. Interestingly, a Google search "Dangers of Cyber Bullying" on 13/10/11 gave 310,000 entries. During Semester 2, the author began a resource file of articles and editorials regarding the dangers of children being online – see Bibliography. Interestingly, heightened media interest in the risks of students' use of online communication tools has been identified since early 2010. A number of print, TV and radio editorials during 2011 promoted to the general public the dangers of children's online communication.
- 87.5% rated their interaction and networking with colleagues and community stakeholders in educational forums as 4/5 or 5/5 on the Likert scale.
- 52% of teachers posted or commented on the blog with 28% posting or commenting more than twice. 13% of teachers uploaded images and 7% of teachers uploaded videos to the library.
- 25% teachers reported valuing the digital evidence of learning they accumulated during the project.
- 65% of schools participated in the very successful VC Showcases.

Pedagogy

- The Professional Learning Network established enabled a small rural and a large urban schools to initiate regular VCs and offer new insights for both groups of students.
- Teachers accepted that robots facilitated engagement and perseverance by students in classroom learning.
- 92% rated as 4/5 or 5/5 on the Likert scale their working productively and openly with colleagues in reviewing teaching strategies and refining professional knowledge and practice.
- 46% of teachers observed a development of resilience in their students.

- All participating teachers recommended the project and acknowledged that professional dialogue was promoted through the project.
- 100% of participating teachers supported the integration of the robotic toy, the Bee-Bot or Pro-Bot.
- Teachers were excited to access and share successful integration strategies for engaging their students across Key Learning Areas (KLAs).

Comparison of Blogs

Very successful VC Showcases involved Turramurra North PS, Curran PS, Auburn PS, Auburn North PS, Westmead PS, Birrong PS, Kambora PS and North Ryde PS which shared experiences, work samples and students talking about the use of the Bee-Bots in their schools. Jewels PS, Wahroonga PS, Terrey Hills PS and North Ryde PS did the same for their use of the Pro-Bots.

Jewels PS, Terrey Hills PS, and Wahroonga PS teachers gave permission for their shared Smart Notebook or Glogster resource to be presented at the SMART Teachers Conference in October 2011.

	2010 Bee-Bots	**2011 BBs & PBs**	**2011 Bee-Bots**	**2011 Pro-Bots**	**2011 Edmodo (Private blog)**
Participants	62	46	39	7	34
Posts	98	108	74	34	9
Comments	157	79	56	23	8
Shared Resources					10
Images	237	127	120	7	
Videos	9	17	16	1	
Visits	4658	N/a	N/a	N/a	N/a

Feedback

Teachers comment about the place of the blog, and its public face:

"Blog is good for sharing however time is a problem for every teacher. Yes, keep it open to the world as there's not much out there yet on Bee-Bots."

"I think that it opens the door to the outside world and shares the community in the learning that occurs in a 21st century classroom."

"How supportive the online teaching community is. Why? As a further direction for myself to find support and as an aide to share with other teachers."

The project used video conferences (VCs) to support participants and culminate participation. As participants grew in familiarity and confidence, they began to use VCs.

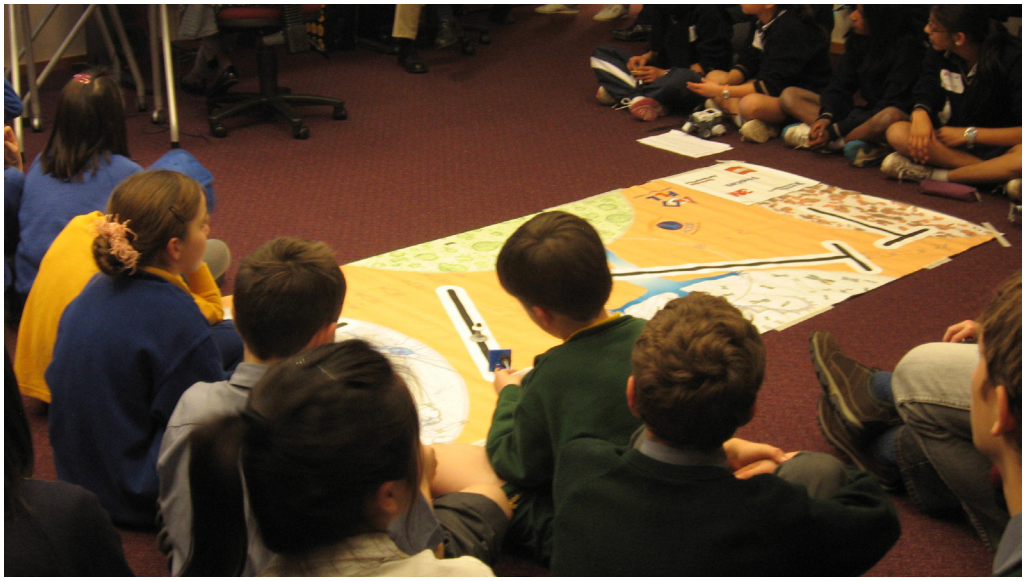
"Integrated use of technology, specifically VC, and improved ability to set up VC and engage students in the experience" as a indicator of improved teacher practice. Another teacher reported learning "How to use flip videos/ video conferencing and how to teach this in a meaningful way to students".

In 2011, time pressures in schools made even meeting for the Support VCs problematic - needing to synchronise timetables to meet in their own time. The support VCs were poorly attended but seemed to conflict with many teachers' personal and professional activities. Iteration 1 held only one support video conference, which was poorly attended but interestingly, a couple of teachers apologised for their absence and enquired if additional support VCs could be arranged. As a result of this feedback, Iteration 2 offered 2 support VCs which were advertised to all 2011 and 2010 project participants.

Burraga PS (a small, rural one-teacher K-2 school) initiated a relationship with Auburn North PS (a large Sydney K-6 school) by VC. Both schools joined the project with the stated desire to improve spoken and written literacy in the students. ANPS has a high percentage of English as a Second Language students. A Kindergarten from ANPS and all of BPS students met by VC to enable sharing of their efforts with the Bee-Bots. Whilst meeting by VC students obtained insights into the similarities and differences between their communities and the teacher oberved:

"Our VC experiences with Auburn North were insightful - the city kids were so far ahead of us across all developmental domains."

To minimise disruption to teachers, students and the schools, the projects culminated in a Showcase by VC. The concept of showcasing the students' journey by meeting over VC was well received. Teachers were encouraged to view the VC Showcases as "a school assembly over the air." Teachers were comfortable with this analogy and students



presented a short overview of their learning with the robots. Each school had some students talk about the resources, some demonstrated the resources, all were well prepared by their teachers. The Showcase VCs were recorded and analysed for data about the implications of the robots on the teaching and learning in the schools.

Improved student outcomes were documented by teachers through "Video and photographic evidence of students working with their Bee-Bots as our work was practical not written". Also "ongoing assessment, photos of students working together" and "I have filmed the children and collected some work samples. Observational evidence". All responding teachers noted improved student outcomes including:

"students who usually don't participate in activities during class time were participating with the bee bots."

"It was interesting to observe the students as they worked out the appropriate commands for the Bee Bot. I was so impressed by how the students were communicating with each other and how they discussed routes and new discoveries with each other."

"One student in particular who normally has a teachers aid full time asked if he could teach a new student how to use the Pro-Bots. I watched as he delivered a very informative instruction and was so proud of himself."

"I felt that my students who are not very confident when sharing in whole class discussions were in their element. Bee-Bots are hands on and they grasped how to use the Bee-Bots quite quickly. Students who would not usually raise their hand during discussions would be leading it."

Teachers observed a development of resilience in their students:

"Yes across all KLA's and blended in well with our 'You Can Do It' program."

"Yes it certainly did. The students were so engaged in the robots that even if their commands did not work they did not feel like they were being judged. We successfully used Bee Bots for spelling and this was wonderful for the more reluctant spellers."

"Yes. Students became more resilient in writing activities in the hope that they would be able to use the Bee-Bots again."

"Yes, the students were using the language connected with resilience when working on other tasks,(eg in maths, eg try again, maybe there's a different way). They also taught older buddies how to use the robots and used similar language."

Principals looked favourably on the chance to have K-2 teachers engaged with "new" technology – Connected Classroom and blogs as well as using a robotic toy. The unsuitability of BlogED for this

project was not a major issue as teachers developed an understanding of, and skills in using, blogs in general. Conversation indicated:

"Teachers reports increased student engagement; robots made learning fun; students seem to be getting through more work. They make maths fun."

"Judy was initially anxious about using the robots & being in the project as she works only part-time. Now she is very confident and committed to using them in her classroom. She has taken her class into the other 4 Y1s to act as expert robot leaders and undertake peer teaching of the use of the robot. This has led to the other teachers beginning to integrate them into their classrooms. Judy has made some of her own floor mats."

"Classes participating have some special needs kids – Autism Spectrum Disorder. Teachers have reported that the Bee-Bots have been very useful with these kids. In fact, for 2 Autistic kids they are 'the best thing since they've been at school.'"

Teachers Evaluation Completion Rates from MyPL@DEC:

Completed	35
Not Completed	25
	60

Special Event - LEGO NXT Challenge Day

Description

In August, Dr Eric Wang, an internationally recognised expert in the implementation of LEGO NXT and RCX robots into schools was invited to lead a LEGO Challenge Day at MacICT.

To extend the professional learning value of the day a series of VCs were scheduled. The day began with a VC for teachers in which Dr Wang addressed teachers on the future of robotics, NXTs in space, and answered questions. The day for the students, either at MacICT or in their own schools began with Dr Wang giving the students a “child-friendly” talk about the future of robotics and his use of NXT robots for research.

Dr Wang presented the students with 3 challenges to attempt in the time available. Students then collected their equipment, worked a team to negotiate the design and construction of the robot to suit their chosen challenge/s, built, programmed and tested the robot to undertake the challenge.

Dr Wang circulated through the teams at MacICT to interact with the students personally. As well, representatives from Macquarie University Faculty of Engineering, supported students both in person at MacICT and by phone for the remote schools.

At midday, Dr Wang held a Question and Answer session to advise the students (both in MacICT and by VC) of possible strategies. He also spoke with the visiting teachers. Students continued working on their challenges. The day concluded with teams given the chance to present their solutions. Teams in remote schools presented over VC.

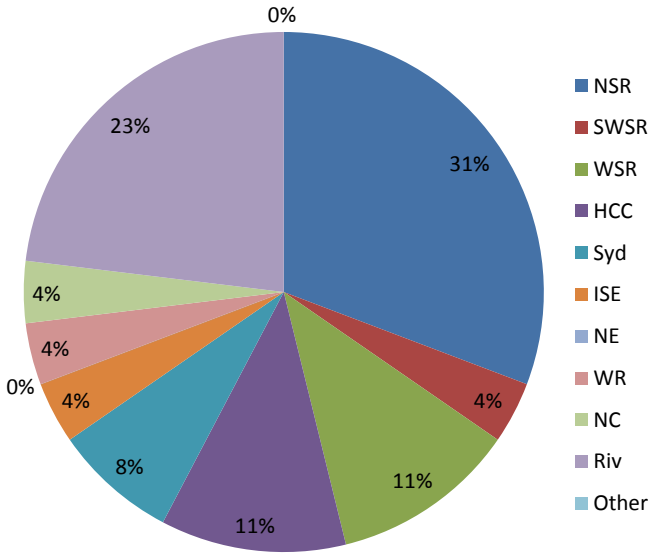


Fig 4. LEGO NXT Challenge day participants by region

Participation data

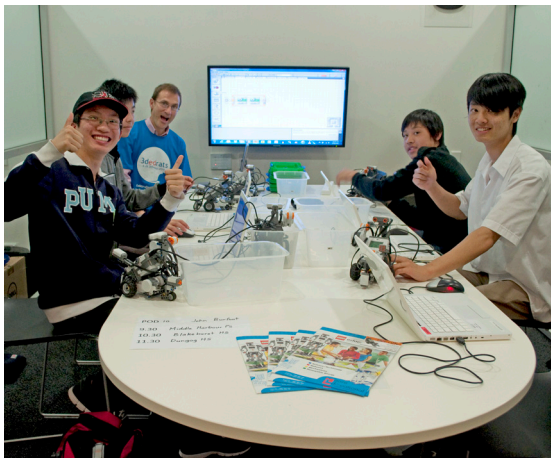
SCHOOLS	Students	Teams @ MacICT	Teams @ School
Marsden HS	4	1	
Wyong HS	28		5
Epping Boys HS	4	1	
Young HS	8		2
Lindfield PS	11	2	
Hornsby Girls HS	8	2	
Woodenbong CS	4		1
Sackville St PS	8		2
Leeton HS	8		2
Pleasant Heights PS	4		1
North Sydney DS	8	2	
Temora HS	6		2
North Sydney G H S	12	3	
Colyton HS	8		4
Melrose Park PS	4	1	
Collaroy Plateau PS	4	1	
Total	**129**	**13**	**19**

Findings

Enquiries about the LEGO NXT Robot Challenge Day 2012 event have been received. The presence of Macquarie University's and Australia's First LEGO League co-ordinator and a team member afforded expert advice to teams both at MacICT and in their own schools. This was appreciated. The initiation of the VC tutoring of Woodenbong CS in November 2011 reflects the value of MacICT's support of schools, be the local or remote.

Feedback

"Many thanks for a great day yesterday. Our Collaroy Kids were very excited b7t exhausted after their day. They learnt many things about their robots but more importantly about teamwork. Please pass on our congrats and thanks to all of the MACICT team. Sue was amazing in the way she ran the event and navigated her way through the little VC challenges etc"- Lizzie Smith, Collaroy PS



Special Event - So You Think Your Robot Can Dance

Description

As part of MacICT's October 3dedrats festival the 'So You Think Your Robot Can Dance' event was designed to celebrate robotics and science in the classroom. Held on the 25th of October 2011, the day consisted of a series of Robot Boot Camps and a Guinness World Record Attempt.

The Robot Boot Camps were held in the new state of the art Macquarie University Library. These workshops were specifically tailored to each school group by grade and robotics experience. Beginners were able to use robots for the first time and experienced users were introduced to new robots.

These workshops were run by a variety of experienced teachers and industry specialists including the First LEGO League (FLL) team Project Bucephalus (Winning Australian team at the 2011 World FLL Competition) and First Robotics Competition (FRC) team. These teams provided a fantastic oppourtunity for student to student mentoring.

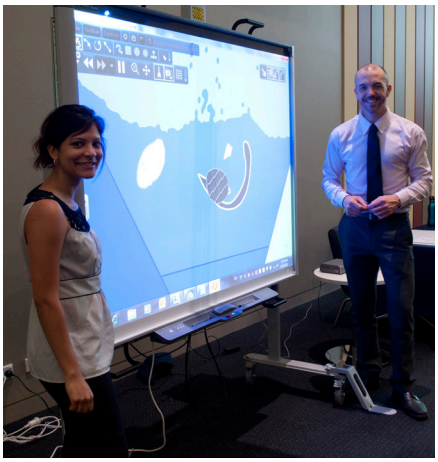
High school and primary school students were able to share their knowledge and experience with each other using orbots such as the Bee-Bot, Pro-Bot, LEGO NXT and Ed-E humanoid robot. By having small teams the students were able to get valuable face time with the more experienced workshop runners.

It was then time for the official Guinness World Record Attempt for the most robots dancing to a piece of music at the same time. Students (and ???? Robots) from across NSW joined together to set the record.

Feedback

"It was wonderful for our students to be involved. The journey was worth it. We have been able to make some plans for bringing the excitement of robotics back to the rest of our country students." - Pauline Mitchell, Principal, Gresford Public School

"Thank you for a wonderfully exciting and well organised day on Tuesday. Our students and teachers from Middle Harbour Public School had great fun in the workshops and being part of the new World Guinness Book of Records attempt for the most robots dancing. Our robots loved the day too!" - Susan Dooley, Rel. Assistant Principal, Middle Harbour Public School



Participation Data

World Record	Students
Gresford PS	18
North Ryde PS	32
Middle Harbour PS	43
Dungog	10
Holy Cross College	10
Kyle Mayer	1
James Cook BHS	6
Blakehurst HS	20
Caringbah PS	50
MQ Elec Eng faculty	13
Project Bucephalus	6
FRC Team	6
Total	**215**

Workshops	Students
Gresford PS	18
Middle Harbour PS	43
Dungog	10
Holy Cross College	10
Kyle Mayer	1
James Cook BHS	6
Blakehurst HS	20
Caringbah PS	50
Total	**158**

Findings

This event was a great success. Students from kindergarten to Year 10 participated, some travelling 4 hours to participate. DEC sent a reporter and photographer and Channel Nine Sydney sent a film crew to record the record. The Bootcamps to introduce robots to students were highly regarded by the teachers for their fun, challenge and the opportunity to be introduced to the robots. The NXT workshops lead by students (aged 9- 16) were acclaimed for having passionate young experts providing outstanding role models for the visiting students.

Gifted and Talented Enrichment Program

Description

In 2011, the Primary Enrichment & Challenge Program for Stage 3 (based in the Northern Beaches Secondary College) and Davidson High School's Year 5 Enrichment Program gave students a one-day experience of LEGO NXT and Ed-E, humanoid robot.

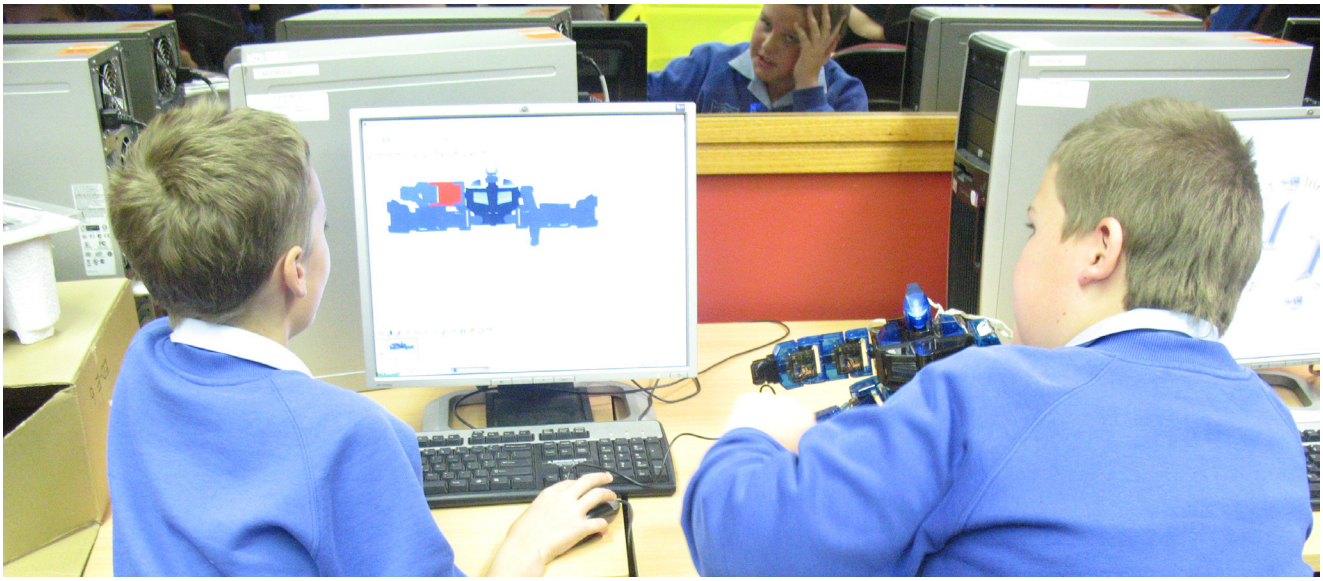
Participation data

Robot	School	Students
LEGO NXT	Cromer Campus	18
LEGO NXT	Freshwater Campus	21
Ed-E	Cromer Campus	18
Ed-E	Freshwater Campus	21
LEGO NXT	Davidson HS	22
LEGO NXT	Cromer Campus	22
LEGO NXT	Freshwater Campus	25
Ed-E	Cromer Campus	22
Ed-E	Freshwater Campus	25
LEGO NXT	Davidson HS	24
	Total	**218**

Conclusions

MacICT's 2011 Robots in the Classroom Project is proving to be an effective vehicle for the enhancement of student learning through structured teacher professional development, the creation of a professional learning network and ongoing VC support. Teachers recognised the value of robots as a tool for learning and saw improved student outcomes. They acknowledged personal and professional growth in their use of various technologies. Extending this project in 2012 to both DEC and non-DEC would provide the opportunity to analyse the teachers' need for a professional learning network which shared observations and reflections of classroom activities.

Robotics was also well received with interest for 2012 being expressed already. Gifted and Talented Enrichment Programs offer students the opportunity to be challenged and supported in a group of like-minded students. MacICT has a long-standing and much valued role in supporting these GATS programs.



Potential for development

Robots in the Classroom

- Continue private blog to disseminate MacICT IP resources.
- Continue the public blog and protocols established in 2010-11 - data acquisition is essential.
- Introduce a Twitter group for the non-DEC.
- Maang as the location of the PLNF for DEC.
- Continue the virtual meetings, offering Skype for non-DEC participants as well as Bridgit for DEC schools.
- Face-to-face interview evaluation in Term 4 augmenting online evaluation strategies.
- Actively search for schools using the most sophisticated robots.
- Robots in the Classroom project be offered to all Australian schools in 2012.
- Continue and extend the current links with the First Lego League, First Robotics Competition (supported by Macquarie University's Faculty of Engineering) and Robocup competition.

The LEGO NXT Challenge Day

- Be offered in 2012 to both DEC and non-DEC schools in the same way as 2011.
- A maximum of 10 teams present in MacICT, consider accessing MQ classroom space to offer participation at MQ for additional teams.
- Remote schools linked using the NBN increased capacity to VC using Skype and Bridgit as appropriate.

So You Think Your Robot Can Dance

- Advertising needs to be undertaken at the start of the year, if not in December 2011, to enable schools to schedule the event into their calendar.
- Links established with DE Hub (Armidale) are ideal to build this event to a simultaneous record attempt in two synchronous locations.

Gifted and Talented Enrichment workshops.

- Extend links to FLL and FRC teams
- Establish mini-FLL activity workshops by working with Luan Heimlich, organiser of FLL and MQ Engineering.
- Introducing a FLL focus would offer the passionate GAT students a pathway to extend their passion for robotics

Apendix A: Links to MacICT Strategic Plan

STRATEGIC PLAN OBJECTIVES	PROJECT ACTION
Professional Learning	
1.1 Course and project evaluations will be highly rated and regarded	Complete project plan - Project facilitator. 'Teacher training day' reflection completed.
1.2 Teacher registrations in courses will be in high demand	Promote project online, by personal contact and through showcase.
1.3 Course and project evaluations will drive the directions of the projects	Final report.
1.4 Teacher candidates for deployment at MacICT will be of a high quality	Possible candidates familiarize themselves with MacICT through participation in project.
1.5 Recognition and accreditation is available with all courses and projects	Accreditation with NSW Institute of Teachers gained.
Students' and Teachers' Participation	
2.1 School participation in projects will be sustained throughout the course of the project	Teachers submit work samples from self and students to blog.
2.2 Improved data collection	All data collection will require teachers and students to complete pre- & post-project surveys, interviews and testimonials.
2.3 Online collaboration between teachers and students will increase	Bee-Bot blog will be used as a collaborative space for learning.
2.4 An increased focus on middle years students in Centre projects	Pro-Bot schools will have access to a complex robot suitable for Stages 2-4
Partnerships and Research Links	
3.1 Increased industry partnerships	Links with RM Technologies maintained.
3.2 Increased collaborative research with University	Kate Highfield (MQ) explicitly supported project;
3.3 Extend the current reach of the Centre, ideally across the State and possibly globally.	EOI sought from across NSW. Links to ICT Learning Innovation Centre (Education Queensland) to be considered. International recognition of the project evident in ongoing global viewing of the 2010 blog (28 Apr 2010 to 24 May 2011: 3,720 visits – UK 787, USA 400) and citations in international publications.
3.4 Continue to engage in sharing and discussion of research and innovation with online communities of educators	Publishing of findings documented through appropriate publications e.g. Side By Side, MANSW newsletter.
3.5 Partnership collaboration will inform direction of projects and professional learning	Reports into each term's outcome/s to drive future directions of research and innovation.
3.6 Partnerships will include international research collaborations and linkages	To be discovered and verified. Global interest in viewing the blog continues at a high level.
Research Projects	
4.1 Focus on risk taking innovation to explore and explain pedagogical opportunities and to research pedagogical practices in specific disciplines	Linked to the research question. Consider using a social networking tool feed on blog to encourage communication.
4.2 Research leadership will be strengthened	Research development opportunities will become evident as a result of this project thus strengthening MacICT research leadership.
4.3 Research support will be provided	Kate Highfield (MU)provided explicit advice as to teaching and learning stimuli.
4.4 Research productivity and accountability will occur through publications derived from each Centre project	Project team will publish reports for research, technology innovation and teacher journal publications. Presentations at Conferences as appropriate.
4.5 Research productivity will be effectively translated into innovative teaching and learning practice	Effective classroom teaching will be fostered with teachers gaining confidence to encourage students to lead learning as and when appropriate.

Appendix B: Links to North Sydney Region Plan

Robots in the Classroom	
Regional Targets	*Differentiated Learning Programs* Improve access to differentiated curriculum for all students in the Early Years.
Delivery strategies	At least 7 video conference information and teacher training and support sessions throughout the project; two teacher training workshops in robotics and blogging each iteration; optional in-school student training workshops for concept and skill development; ongoing student-centred learning activities using robotic learning technologies.
Assessment and evaluation strategies	MyPL@DEC teacher evaluations; Teacher blog reflections and comments; Evidence of online teacher sharing practice; Student activity work samples cited through the blog; Student activity work samples cited during video conferences; Final student showcases - sharing video conference showcase.
Regional outcomes	All students access robotic learning technologies.
Regional indicators	Robotic learning technologies are embedded into teaching and learning activities.
Issues and resolutions	Administration of the Blog was controlled by MacICT blog master. In Week 7, Term 2 the author received administration rights to add users. Collection of data from MacICT blogs is not available. Cost of purchasing robots and software limits or excludes many schools. Industry partner (RM Asia-Pacific) announced special packages of robots, software and a range of resources for participating schools.
Achievements	In 2011, 14 schools (300+ students) participated.
Future plans	Interest from NSR schools with NXT encouraged the expansion of the scope of the project to include Lego NXT and ED-E, humanoid robot.

Robots Project	
Regional Targets	*Differentiated Learning Programs* *Improve access to differentiated curriculum for all students K-12.*
Delivery strategies	LEGO Robots Challenge Teams of 4 students worked either at MacICT or in their own school and linked by VC. So You Think Your Robot Can Dance One-hour workshops presented the students with an unfamiliar robot prior to the Guinness World Record attempt.
Assessment and evaluation strategies	MyPL@DEC teacher evaluations; Student activity evident on the day at MacICT; Student activity cited during video conferences;
Regional outcomes	All students access robotic learning technologies. Teachers receive expert support in leading Robotics.
Regional indicators	Robotic learning technologies are embedded into teaching and learning activities.
Issues and resolutions	LEGO Robots Challenge: Support to remote school via VC and phone links to experts. So You Think Your Robot Can Dance – Distribution and collection of the share robots; ownership of the Record attempt not with MacICT.
Achievements	In 2011 28 schools participated in the Robotics events. LEGO Robots Challenge – 149 students (54 students at MacICT, 95 at their own school) So You Think Your Robot Can Dance - 215 students
Future plans	Interest from many schools in repeating these events in 2012

Robots Project	
Regional Targets	*Differentiated Learning Programs* *Improve access to differentiated curriculum for all students participating in these programs.*
Delivery strategies	A one-day workshop, either at MacICT or in the host High Schools, enabled students to work in small, like-minded groups of highly able Stage 3 students to use MacICT's LEGO NXT or Ed-E, humanoid robot.
Assessment and evaluation strategies	Student activity work samples observed during the day by the organising teacher;
Regional outcomes	All students access robotic learning technologies. Students have a learning environment that both challenges and supports gifted students to pursue excellence.
Regional indicators	Robotic learning technologies are embedded into teaching and learning activities.
Achievements	In 2011 5 schools (73 students) participated in the enrichment workshops.
Future plans	NSR schools plan to continue in 2012.

Appendix C: Quality Teaching Framework

STRATEGIC PLAN OBJECTIVES	PROJECT ACTION
Intellectual Quality	
1.1 Deep knowledge	As a result of progressive instruction • Students are able to build a sequence of instructions to complete the full task in one programming sequence. • Students develop an automatic approach to recognising and using direction, perspective and spatial awareness - especially left, right, forward, reverse, beside, behind, etc. • Students recognising and select objects based on their stacking suitability when constructing "real world" landscape representations for the Bee-Bot to move around. Videos of students demonstrates student knowledge e.g. mapping, position in a hands-on physical context Vs a pencil & paper method. Videos of students demonstrate student-lead learning.
1.2 Deep understanding	• Students demonstrate the use and manipulation of a robotic toy in problem solving, developing explanations, drawing conclusions and exploring relationships. • Deep understanding by actually programming the robot and "doing the task". • Individualised extension. • Success in the task.
1.3 Problematic knowledge	• Methodology of problem-solving • Is deeply embedded whilst using robots, especially in Working Mathematically. • Negotiation, justification of points of view. • Technical skills.
1.4 Higher-order thinking	• Students' thinking was extended • When teachers allowed/encouraged deeper thinking. • Pattern-making skills: develop from simple to sophisticated • Manipulative and technical skills were used in a problem-solving context and when dealing with the unexpected. • Students "rehearsed" their solutions sometimes one step at a time, but with increased confidence and understanding, students attempted complete solutions. • Beyond recall by changing the context of the task: "What if ...." scenarios. • Higher Order Thinking is deeply embedded when students use robots, especially when attempting the higher order tasks.

1.5 Metalanguage	• Student used • Direction cards as a written communication tool. • Technical terms – initially: reverse, forward, left, right, pause, clear; in context using the 100's chart: rows, columns, decades, patterns. • Verbalise thinking / planning of a specific pathway/route using technical language. • "Focus on Bee-Bot" Software implicitly fosters metalanguage.
1.6 Substantive communication	• Students undertook prolonged two-way communication in negotiating programming solutions. • Provided clear instructions when directing others' programming of the Bee-Bot. • Justified their suggestions and /or directions to others. • Focus on the task for long periods.
Quality Learning Environment	
2.1 Explicit quality criteria	Teachers gave explicit instructions (both verbal and visual) as to the task to be attempted. These were reinforced throughout the task, "Does your attempt meet the task as explained?" Students reflected on their efforts and attempted alternative solutions which the students believed better met the task.
2.2 Engagement	All teachers and students reported high engagement with the Bee-Bot. Teachers valued teacher-developed floor mats more than some published mats.
2.3 High expectations	Students were supported to attempt risky programming in a safe environment and derived rewarding participation and satisfaction. Teachers expected that students would succeed, so the students did succeed.
2.4 Social Support	• Teachers asserted that Bee-Bots are not a single-user activity. Bee-Bots were most suitable for groups of 2 – 6 students. • Teachers recognised the role of peer-tutoring in mixed ability groups. • Teachers supported the classroom protocol of "Ask 3 before me" to encourage social support. • Teachers reported that students "rehearsed" on task learning/ behaviour (either doing or watching) which carried over into other teaching and learning contexts. • Using Bee-Bots in a classroom explicitly incorporates students experiencing and dealing with the risk of failure when programming the robot. Teachers model risk-taking behaviour whilst providing positive and supportive encouragement. • Teachers reported students' balanced individual effort with socially aware provision of support for each other when it was sought.

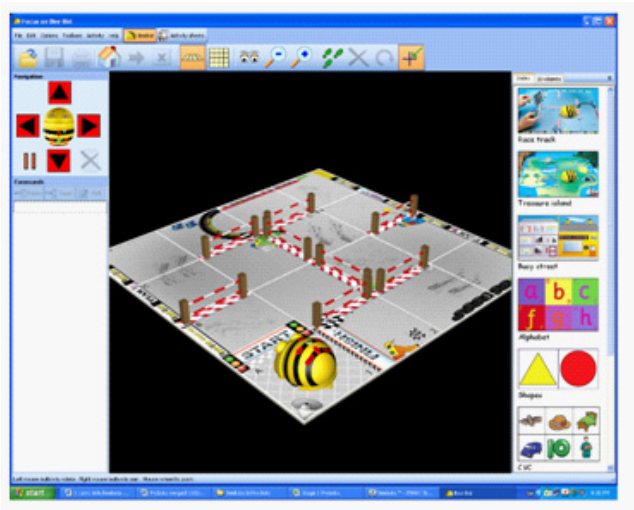
2.5 Students' Self-Regulation	Due to the high student engagement and focus, students demonstrated self-discipline, respect for the fragility of the Bee-Bot
2.6 Student direction	• All teachers reported that student initiative and autonomous activity was recognised. The project encouraged student-directed learning. • Students were able to be offered further activities independently, as a small group, as a whole class, with other classes.
Significance	
3.1 Background knowledge	Teachers provided links between the known and unknown e.g. School Vs family contexts, home use of technology, similar toys at home.
3.2 Cultural knowledge	• Teachers were able to integrate cultural knowledge in students' cityscapes when buildings were incorporated and identified as having cultural significance. • Teachers might choose to develop a specific mat designed to incorporate Aboriginal symbols into the Teaching and Learning Activities. • English as a Second Language (E.S.L.) students experienced an enhanced development of language in a "hands-on" context.
3.3 Knowledge integration	• Students demonstrate knowledge of left/right in context. • Teachers noted that the spelling tasks were dependent on a basic knowledge of the alphabet in a spelling context. • Integration samples provided with the blog offered teachers the stimulus to "think outside the box". The Bee-Bot was integrated into dance lessons, HSIE, literacy and numeracy.
3.4 Inclusivity	• The nature of the student engagement ensured that all students participated actively and had their contribution/s recognised and valued. • The use of the Bee-Bots in the classroom overcame • Financial difficulty in some home in offering access to technology. • Gender discrimination • Parental attitudes which perceive technology as a poor alternative to outside active play.

3.5 Connectedness	• Culturally significant contexts appropriate to each classroom were integrated into teacher-designed floor mats. • Students connected culturally with "their group" in a safe communal environment. • Naming the class Bee-Bot fostered a sense of connectedness. • Teachers noted overlap in cross—curriculum learning. • Teachers observed that students were connected to other students with similar learning styles. • Teachers and students are connecting between schools at the Project Showcase on 29/7/2010. • Teachers and students are planning their tasks so that other classes benefit from their experiences. • Articles included in the School Newsletters. • GPS students have privately purchased Bee-Bots and parents are organising Bee-Bot Play Dates.
3.6 Narrative	• Teachers presented their lessons in the form of a story to link the sequence of learning e.g. making the Bee-Bot home, and linking the published adventures to class, school and community. • Teachers were able to link Bertie Bee-Bot, living at MacICT, to their own Bee-Bot's context as cousins which was noted as fostering high student engagement. • Teachers are integrating Bee-Bots into cross-curriculum tasks, e.g. Cityscapes at GPS to help bring alive the learning task. • Teachers are offering students the chance to link personal experience and imagined story when using student-designed tasks to assist other students to demonstrate understanding.

Appendix D: Technical Report

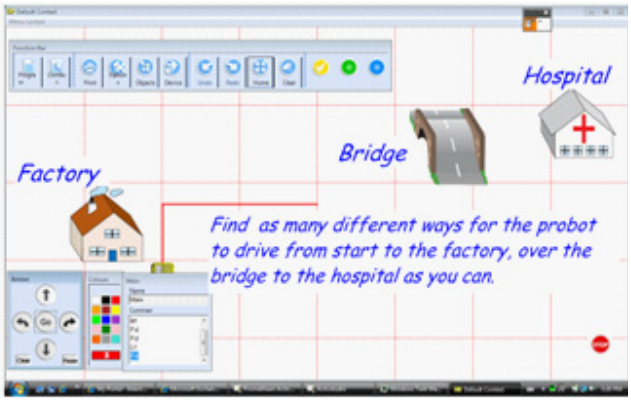
Bee-Bots

The Bee-Bot is a programmable floor robot for the beginner learner that can be used in a variety of subject areas including literacy, maths, art and HSIE. It has a robust, small design with clear and bright buttons sounds and flashing eyes confirm instructions. It moves accurately in 15cm steps at a time and turns in 90° and has a memory of up to 40 steps. A variety of Bee-Bot accessories are available to enhance its teaching and learning affordances. “Focus on Bee-Bots” software supports the students’ use of these robots.



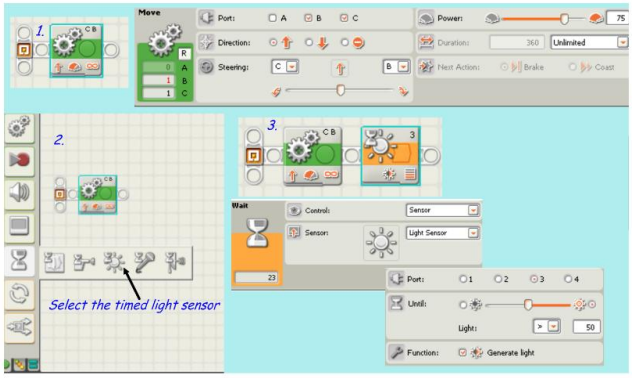
Pro-Bots

The Pro-Bot is an advanced floor robot which has a bright attractive car design, with child appeal. It is robust and durable to withstand everyday use and can operate independently or alongside a PC using the software “Probotix 1.0”. Pro-Bots can be used simply by programming arrows or using more complex commands. Routes taken can be drawn using a simple pen mechanism and a standard felt tip pen. It has fully functional headlights using light sensors, voice activated functions, bumper sensors and 4 locators points on the body which allow the use of K’NEX to modify the appearance.



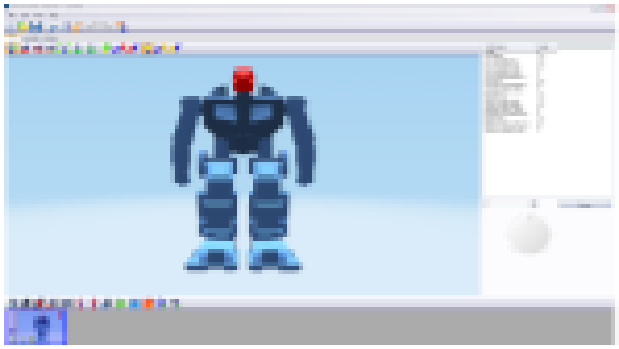
LEGO NXT

The NXT robot is the most advanced and sophisticated of the robotic programs offered at the Macquarie ICT Innovations Centre. Helping students' to grasp science, technology, engineering, and math concepts within a curriculum context, the NXT robot offers a hands-on experience to enhance students' learning. MINDSTORMS® Education software offers a user-friendly, icon-based interface that enables drag-and-drop programming. The low threshold, high ceiling nature of the software enables programming at all levels, making the NXT Robot relevant for ten year olds as well as senior high school students.



Ed-E Humanoid Robot

ED-E is a fully assembled, programmable humanoid robot which is designed to help students engage with and learn about programming. It has 17 servo motors capable of 180 degrees of movement. Ed-E has easy to use software with audio files and 100+ built-in motion files. It has a fully programmable remote control. Students can use this robot in cross-curriculum problem-solving. The programming of the robot is done via a computer that uses a simple drag and drop interface. The moves are placed in a "movie frame" style box. After multiple entries a "movie strip" of different movements can then be previewed on the screen and uploaded to the handset, allowing ED-E to act out the motion file. The concept of this project is to incorporate the skills of talented students across the curriculum, but specifically those in Music, Dance, and Computing.



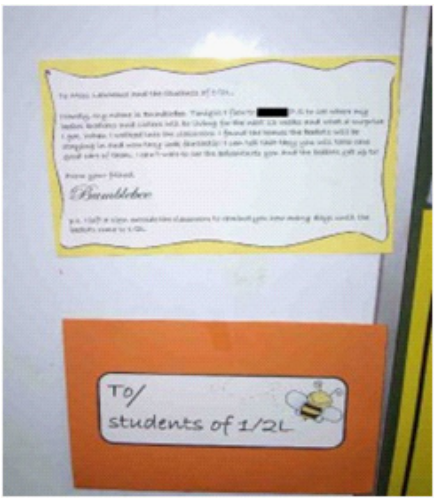
Appendix E: The blog and work samples

The blog is a repository of teachers sharing. In 2011 there are as many videos as photos. The most valuable sharing of worksamples happens during the support and showcase video conferences. MacICT adopted a WordPress blog for Robots in the Classroom teachers.

Characteristics of WordPress blog:
- Enabled the administrator to set access rights so that only registered participants had authorship.
- This blog enabled multimedia posts including text, images, sound and video.
- Public to a global audience.
- Provided opportunity for discussion of cybersafety with protocols and policies outlined.
- Fostered and created a real-life purpose for the use of a range of rich and varied technology tools in the classroom.

Edmodo:
- Invitation only - A private blog for use by participants to access resources over which proprietary interests were held.

Blogging:
- Enabled embedded technology use with teachers using ICT including email, interactive whiteboards, digital cameras, digital editing, online video repositories and word processing.
- Supported teachers to make digital recordings of student work samples using stills and video cameras.



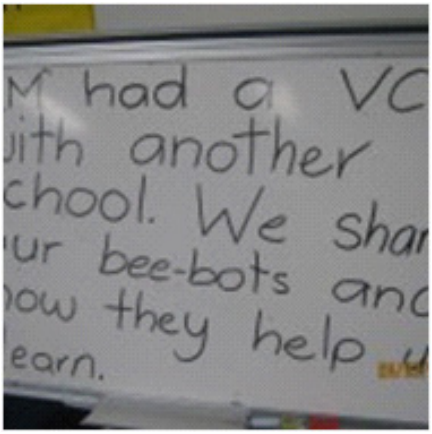
Letter to 1/2L

Howdy, my name is Bumblebee. Tonight I flew to ### P.S. to see where my Bee-Bot brothers and sisters will be living for the next 12 weeks and what a surprise I got. I wlaked into the classroom. I found the homes the Bee-Bots will be staying in and wow they look fantastic. I can tell that you will take care , good care, of them. I can't wait to see the adventures you and the Bee-Bots get up to!

From your friend,

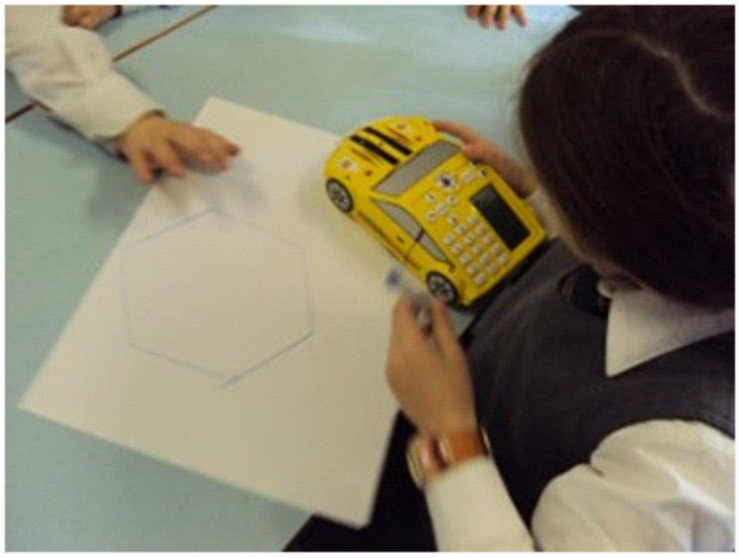
Bumblebee

P.S. I left a sign outside the classroom tp remind you how many days until the Bee-Bots come to 1/2L



Students from KM had an amazing experience using Video Conferencing,.. not once, but twice! They spoke to students from a school near Bathurst through VC and shared the names of their bee bots. The other school also owned bee bots and explained that they were making a special beehive for their bee bots.

The next time KM VC'd with the school, they had already made an amazing beehive made out of paper mache and painted yellow and black. KM watched as the students programmed their beebots to travel inside their beehives from 4 different sides of the beehive.



Year 2 students exploring 2D shapes using the Pro-Bot

Y1 students testing to determine the length of a Bee-Bot “step”.

Y1 students ask, ‘How many Bee-Bot moves would it take to measure me?’

Appendix F: Project Resources

Resources were made available to all registered participants in the project.

Material restricted to these participants was posted on the Edmodo blog.

Resource	Nature	Purpose
2011beebots	Smart Notebook	Introduce Bee-Bots to the classroom
2011probots	Smart Notebook	Introduce Pro-Bots software to the classroom
2011probotsoftware	Smart Notebook	Introduce Pro-Bots to the classroom
Integrating Beebots into Classrooms TL program	Word pdf	Sample of Cross-curriculum integration opportunities
Integrating Probots into Classrooms TL program	Word pdf	Sample of Cross-curriculum integration opportunities
This animate was adapted from a talk given at the RSA by Sir Ken Robinson	video	Stimulate conversation about the purpose and nature of the current education system
Summary of Quality Teaching elements	Word pdf	Ensure all teachers have & understand metalanguage of QT
Qt Overview Intellectual Bbs	Word pdf	Synthesis of most commonly met elements as recognised by teachers in 2010 iterations.
Qt Overview Quality Bbs	Word pdf	Synthesis of most commonly met elements as recognised by teachers in 2010 iterations.
Qt Overview Significance Bbs	Word pdf	Synthesis of most commonly met elements as recognised by teachers in 2010 iterations.
Qt Overview Intellectual Pbs	Word pdf	Synthesis of most commonly met elements as recognised by teachers in 2010 iterations.
Qt Overview Quality Bbs	Word pdf	Synthesis of most commonly met elements as recognised by teachers in 2010 iterations.
Qt Overview Intellectual Pbs	Word pdf	Synthesis of most commonly met elements as recognised by teachers in 2010 iterations.
Qt Overview SignificancePbs	Word pdf	Synthesis of most commonly met elements as recognised by teachers in 2010 iterations.
Bee-Bot Challenge 1	Word pdf	Sample of teaching/learning activity
Ideas for Electromat and Constructa-Bot	Word pdf	Sample of teaching/learning activity
Beebot 1st Adve	.ppt	Sample of teaching/learning activity
Beebot 2nd Ad	.ppt	Sample of teaching/learning activity
Beebot 3rd Adv	.ppt	Sample of teaching/learning activity
Beebot 4th Adv	.ppt	Sample of teaching/learning activity

Beebot 4th Adv	.ppt	Sample of teaching/learning activity
Beebot 5th Adv	.ppt	Sample of teaching/learning activity
Beebot 6th Adv	.ppt	Sample of teaching/learning activity
Beebot about your school	.ppt	Sample of teaching/learning activity
20 Reasons students should blog	weblink	Stimulate conversation about the purpose and nature of blogs
About Blogs	weblink	Stimulate conversation about the purpose and nature of blogs
My Beebot	weblink	Model expectations by viewing 2010 blog
Upload tutorial on Viemo	weblink	Assist in uploading of videos to blog
Vimeo basics	weblink	Assist in uploading of videos to blog
Embedding photos, video & audio into your posts	weblink	Assist in uploading of videos to blog
Protecting Reputations Online in Plain English Common Craft	weblink	Support participants in mentoring colleagues
Creative Commons Search	weblink	Support participants in mentoring colleagues
About creative Commons	weblink	Support participants in mentoring colleagues
All Right to Copy?	weblink	Support participants in mentoring colleagues
Creative Commons for Australian Schools	weblink	Support participants in mentoring colleagues
Bee Bots Project permission photos videos recording work samples	Word pdf	Project essential procedure
Pro Bots Project permission photos videos recording work samples	Word pdf	Project essential procedure
Web 2.0	Smart Notebook	Support participants in mentoring colleagues
Copyright	Smart Notebook	Support participants in mentoring colleagues
Blogging	Smart Notebook	Support participants in mentoring colleagues
Drawing with a BeeBot	weblink	Sample of teaching/learning activity
The end of Classroom blogging?	weblink	Support participants in mentoring colleagues
Robotics authority to Publish	Word pdf	Project essential procedure
Creative Commons simply explained	weblink	Support participants in mentoring colleagues
Pratt Role Tags 2	Word pdf	Sample of teaching/learning activity
Pratt Probots Group Roles	Word pdf	Sample of teaching/learning activity
Jaycut Web 2.0 Tool of the week	weblink	Assist in uploading of videos to blog
24 32 25 36 Vimeo Vodpod	video	Assist in uploading of videos to blog
27 15 28 00	video	Assist in uploading of videos to blog
MacICT Nxt Lego Robots	Smart Notebook	Introduce Lego NXT to the classroom
Nxt data	Smart Notebook	Introduce Lego NXT data logging to the classroom
Virtual Life after death: journey past the last post	weblink	Stimulate conversation about managing online personal data
How to digitally Record your Video Conference	weblink	Support participants in mentoring colleagues
Download Ipvcr Recordings.	Word pdf	Support participants in mentoring colleagues

Appendix G: MyPL@DET Project Evaluations

Course Question: standard DEC course questions Rating	5	4	3	2	1
To what extent did the course or program address the standard 1.2.4 Apply current knowledge and skills in the use of ICT in the classroom to meet syllabus outcomes in the following: • Basic operational skills • Information technology skills • Software evaluation skills • Effective use of the internet • Pedagogical skills for classroom management?	10	11	3	0	0
To what extent did the course or program address the standard 2.2.2 Apply knowledge of the typical stages of students' physical, social and intellectual development as well as an awareness of exceptions to general patterns?	7	6	2	3	0
To what extent did the course or program address the standard 3.2.5 Use a broad range of effective strategies to assess student achievement of learning outcomes?	9	7	8	0	0
To what extent did the course or program address the standard 4.2.5 Create, select and use a variety of appropriate teaching strategies and resource including ICT and other technologies to make content meaningful to students?	17	6	1	0	0
To what extent did the course or program address the standard 5.2.7 Apply specific requirements to ensure student safety in classrooms?	6	11	6	1	0
To what extent did the course or program address the standard 6.2.4 Work productively and openly with colleagues in reviewing teaching strategies and refining professional knowledge and practice?	13	9	1	1	0
To what extent did the course or program address the standard 7.2.4 Interact and network with colleagues and community stakeholders in educational forums?	11	10	3	0	0

Evaluation Question Rating 4/5 or 5 /5 on Likert Scale	%
To what extent did the course or program address the standard 1.2.4 Apply current knowledge and skills in the use of ICT in the classroom to meet syllabus outcomes in the following: • Basic operational skills • Information technology skills • Software evaluation skills • Effective use of the internet • Pedagogical skills for classroom management?	87.5
To what extent did the course or program address the standard 4.2.5 Create, select and use a variety of appropriate teaching strategies and resource including ICT and other technologies to make content meaningful to students?	95.8
To what extent did the course or program address the standard 6.2.4 Work productively and openly with colleagues in reviewing teaching strategies and refining professional knowledge and practice?	91.7
To what extent did the course or program address the standard 7.2.4 Interact and network with colleagues and community stakeholders in educational forums?	87.5
I will be able to effectively apply what I have learned from this project in my classroom.	80
The project has provided me with practical strategies to use in the classroom	85
The project was a valuable professional learning activity.	80
I will be able to effectively apply what I have learned from this project in my classroom.	84
The project has provided me with practical strategies to use in the classroom	85
The project was a valuable professional learning activity	80

I would recommend the project to my colleagues.	Yes	100%
Did you observe improvement in students' resilience and perseverance when students used robots?	Yes	100%
Do you have evidence that the project has contributed to the implementation of literacy improvement programs in the classroom?	No	25%
	Yes	75%
Do you have evidence that the project has contributed to the implementation of numeracy improvement programs in the classroom?	No	15%
	Yes	85%
The project has promoted dialogue with my colleagues about my work practice	Yes	95%

Evaluation Rating	5	4	3	2	1
How well did the resource materials available on Edmodo complement the project?	1	8	8	2	0
How many of the resources available on the Edmodo blog did you access and use?	2	3	10	3	2
I extended my professional relationships through networking opportunities.	1	3	9	3	3
I will be able to effectively apply what I have learned from this project in my classroom.	11	5	4	0	0
The project has provided me with practical strategies to use in the classroom	10	7	3	0	0
The project was a valuable professional learning activity.	11	5	4	0	0
Rate the degree to which your school provided sufficient resources to allow completion of the project.	11	4	6	0	0

Did you observe improvement in students' resilience and perseverance when students used robots?

yes sometimes subjects such as talking and listening
Yes across all KLA's and blended in well with our 'You Can Do It' program.
No
in other technological areas such as computer programs and blogs.
Yes it certainly did. The students were so engaged in the robots that even if their commands did not work they did not feel like they were being judged. We successfully used Bee Bots for spelling and this was wonderful for the more reluctant spellers.
not really
Yes they strengthened their co-oprative group work skills which flowed into all other KLA's.
It became a focus in our problem solving activities in all KLAs.
Not evident yet.
Too early to tell yet. Will be using the Bee-Bots for the whole year.
Yes
Yes. Students became more resiliant in writing activities in the hope that they would be able to use the Bee-Bots again.
Yes, the students were using the language connected with resilience when working on other tasks,(eg in maths, eg try again, maybe there's a different way). They also taught older buddies how to use the robots and used similar language
Confidence in pragmatic language increases through VC interaction with students and staff from other schools.
definitely - position work improved especially language

Describe any observed improvement in student ability and confidence to become self-directed learners.

students who usually dont participate in activities during class time were participating with the bee bots.
The collaborative learning groups developed to implement the Pro-Bot hands on problem solving tasks offered the students with many opportunities to be responsible for their own learning as an individual, in partnership or for the group as a whole.
More capable students who had a good grasp of English and who had more independence were the students who made the most improvement and demonstrasted the most confidence
More willing to take risks with learning as i feel that they transfer a portion of responsibility to the Bee-Bot so if the answer is incorrect they blame the Bee-Bot even though they were the ones programming the robot. was a good source of encouragement for those students who were afraid to try in case of failure.
It was interesting to observe the stduents as they worked out the appropriate commands for the Bee Bot. I was so impressed by how the students were communicating with each other and how they discussed routes and new discoveries with each other.
more independent group work when Bee bots were used
One student in particular who normally has a teachers aid full time asked if he could teach a new student how to use the Pro-Bots. I watched as he delivered a very informative instruction and was so proud of himself.
The children work collaboratively in groups to solve problems. They also came up with new challenges that they attempted to solve. The skills they develop from the activities-persistence, planning, learning from mistakes, learning that problems can take several attempts and sometimes a longer time to solve- are life long learning skills.
Students overcome their earlier frustrations of wanting to be told how to operate robots. They were more able to problem solve in different situations for a successful outcome.
They all have improved in confidence and peer tutoring.
Students became individual learners and worked well as a team
Students thoroughly enjoyed taking ‘risks’ in their learning when using the Pro-Bots in literacy and numeracy lessons.
I felt that my students who are not very confident when sharing in whole class discussions were in their element. Bee-Bots are hands on and they grasped how to use the Bee-Bots quite quickly. Students who would not usually raise their hand during discussions would be leading it.
At first they just wanted to ‘play’ but they then started enjoying the challenge of completing tasks and designing their own activies
Students were able to move away from concrete mats and make their own obstacle course. Using measurement skills to ensure the robot would be able to navigate obstacles
Students requested opportunities to use the bee-bots in situations they devised themselves.
Students learnt to be patient and take responsibility for their learning.
could confidently describe the path/position of objects

In which Key Learning Areas do you believe robotic toys integrate into the classroom teaching and learning program most effectively?

maths
All KLA's and higher order thinking skills.
Literacy and Numeracy
great thing about Bee-Bots they can integrate into any KLA
As this is an ongoing project in my school, I have so far found that I can effectively integrate the robotic into literacy activities and learning.
literacy
Mathematics.
I think it's a great creative problem solving activity that encourages children to work in groups to discuss possiblities and work to solve together. I think it is an educational tool that combines literacy and numeracy skills in a fun engaging way. The children are very engaged when the ProBots come out to play. The ESL children are immersed in language and I find it is a valuable educational tool for them.
Numeracy,l iteracy & HSIE - using an image of our school environment from google earth and making a mat using the software to compliment the unit - Places we Know.
Maths and English Science
I have utilised the robotics in weekly numeracy and literacy groups lessons.
Maths - it's great for 'hands on' application. I used Bee-Bots for english activities but i didn't find them as useful.
Maths for space and position, but used them in my HSIE/Science integrated units. Eg lifecycle, museum visit, water cycle.
Mathematics
Literacy, numeracy, design, seuencing, problem solving, language and technology
English, Mathematics, HSIE
Literacy Mathematics HSIE
literacy and numeracy

In what way(s) has this project improved your classroom practice? What is the most important thing you learned and why?

I ensure that more practical activities using the Bee bots are included in the program. Students were learning through play
More confidence to implementing student directed oportunities in learning.
When using robotics with kindergarten, it is good to give them time to explore but there stiill needs to be guidence and structure and stimulating activities.
I learnt to expand my thinking outside the norms of the traditionally teaching practice and to take a risk with my own teaching by incorporating Bee-Bots into my teaching
It has allowed me an avenue of teaching and skill set I didn't know I had. I had never integrated robotics into a teaching progrma before and once I started I found the ideas flowed.
improved my classroom practice by allowing students to work more independently in small groups with bee bots
It just allowed me to evaluate and re think how I teach some lessons to make them more engaging and dynamic.
With the help of the resources and blog and Sue Fennell's emails that were full of links to great educational sites, I was able to effectively use robots in the classroom, in group activities. before the project I was at a loss as to how to incorporate the robots into my classroom practice. I was also not aware of the endless possibilities of these educational tools.
Let students have a go. Don't always tell them but get in before frustration sets in. Work collaboratively in pairs and groups.
That children are very intuitive.
Good
I have learnt to effectively utilise robotics technology in numeracy and literacy lessons. This has aided in improving students' learning needs.
Bee-Bots were great for disipline. The Bee-Bots stayed in our classroom during the day and the students were aware that they had to work quietly to ensure the Bee-Bots wouldn't wake up. It taught studnets to be considerate of others.
How to use Bee-bots and their affect on resilience in students. How to use flip videos/ video conferencing and how to teach this in a meaningful way to students
Increased students problem solving skills
Integrated use of technology, specifically VC, and improved ability to set up VC and engage students in the experience.
Explicit instruction is vital for using Bee-Bots in the classroom.
I really am looking at other ways/areas to extend the use of Bee-Bots into the students learning

What evidence do you have to show that implementation of what you have learned from the project has improved student outcomes?

The students engaged in the activities and were learning through play.
Anacdotal evidence, metalanguage application and improved results in rich task assessments.
At this point in time, I do not have evidence to support this.
Video and photographic evidence of students working with their Bee-Bots as our work was practical not written
ongoing assessment, photos of students working together, discussing the bee bots movements towards particular sight words
Observations
I have filmed the children and collected some work samples. Observational evidence
It is too early to tell in our program because the Bee Bots have only just arrived but initial results look promising.
Still a work in progress to early to tell.
Students have a much more practical way of learning
Anecdotal evidence, work samples and post testing of students.
I found that Bee-Bots were amazing during maths lessons, particuarly position. It made quite complicated cancepts such a co-ordinates easy and FUN to understand. I definitely owe my position marks to Bee-Bots!
They have been able to teach what they have learnt to older peers. We kept Bee-bot journals (blank books covered in yellow paper with recorded ideas/thoughts and program designs
Photos and videos
the bee-bots werte a vital resource in the teaching of forward and backward counting sequencces.
ALL STUDENTS are now proficient in using the language of position

Is a public blog the tool for sharing best practice? Should the blog remain open to the world? Is the global audience valuable? Is Yammer Bee-Bot community an appropriate tool?

I didn't use the blogg as much as i should of. I used it for ideas but did'nt contribute to it.
I mainly got spam from people outside the project so therefore it was not value adding to have the global audience for the blog. I have not used Yammer but it maybe useful if you can still integrate the visual images.
I believe so, it's just having time to look at, update the activities occuring in the classroom and then uploading it. As a classroom teacher I found it difficult to find time to do this.
I found that due to poor return of consent that a classroom/school blog worked better in my classroom and students have continued to work on this blog in a range of topics.
A public blog is always great when searching for new ideas and strategies. It would be nice to have it left open to access later as needed.
yes it is important to have a blog open for everyone to use, who is linked to the project.
I believe the blog should be private to allow the teachers more opportunityies to really share and show the students working. If it is public it limits what information can be uploaded and it doesn't make the community bigger as we don't share outside it just allows others to learn from us. Which is okay too but it would be a lot more engaging if the teachers could show the tasks in action with their kids.
I have been on the blog and contributed but I have found the blogs that Sue Fennel sent via email were more helpful. I have not been on the Maang Bee-Bot community as it has just been set up and I haven't had time. I found the Edmodo site very helpful though.
A public blog is a good sharing device. I like to look at comments in Maang. They contain good ideas and often you have the same questions. There are lots of Bee Bot sites with activities but it is good to have ones for use in Australia.
Yes the blog is good.
A more user friendly blog would be more beneficial.
I would prefer it to be a closed blog to educators.
I think it is great. I did have a lot of trouble getting access to the blog, so a couple of blogs turned into 1 big one. A global audience is vaulable as teaching is all about sharing ideas and resources.
I like reading the blog and the kids like finding out about other students laerning with e the Bee-bots. not sure about Yammer, don't use it.
Public blog is a good place to share ideas. The log was how I discovered the project. If it was closed we would probably not have had the opportunity to participate in project
Yes - new ideas can be shared and problems solved.

How can best practice using robots in the classroom be identified? Describe examples of teaching and learning activities with the robot which could be defined as best practice.

In maths it was great using the robots for teaching directions and recognising numbers.
KLA integration with ICT, high and sustained student engagement with ICT, self-directed learning through ICT, varied multimedia presentations, quality communciation with a broader learning community both at home and at school.
helping students identify numbers, letters, sight words, addition,
student led, allowing students to experiment and explore their learning with tools outside of the norm.
best practice, using the bee bots, would be to teach the students how to use them before leaving them on their own to complete an independent activity.
Activities where problem solving skillls are developed and differentiated. I mentioned some on the proBot blog.
Bee Bots have only just come in so we have been using them in Maths and Literacy activities. We hope to be able to use them randomly rather than at specific times so they are truly integrated into all KLA's and T and L activities.
Our school is still discovering what we can do. The majority of K-2 classes (8) are using them, so it has been a slower project than anticipated in sharing the Bee-Bots. We are continuing the project for the year and it will become a fixed activity for K-2 in our ICT Scope/Sequence. It is definitely a worthwhile and meaningful project for all students.
Through effective position, measurement and 2D shapes lessons.
Through the blog and video conferencing. I found the Bee-Bots useful in many KLA's but none more than maths. The subjects ranged from volume and capacity to position. It was great!
Integrating it with the key units (or conceptual framework) you are teaching so that it is not just a one of activity. Let the studenst take ownership by designing activities and bee-bot cards
Meaningful activities requiring students to think outside the box. Integrating other areas of the curriculum, not just directional language.
Lessons that integrate bee-bots in relevant, engaging and challenging ways to promote mastery of outcomes in literacy and numeracy are identified when teachers observe students - listening to instructions, talking aloud as they program and activate the bee-bot, working cooperatively in groups to achieve a goal, practising specific skills with enjoyment, demonstrating skills to parents and school visitors a participating in activities modified to meet their individual abilities.
Using the robots accross a variety of KLAs.
the engagement of the students, the correct language used,
The discussion/talk that came from the students was quite advanced and they would pose their own problems and talked about how they could be solved

Appendix H: Industry Partnerships

WHO	CONTRIBUTION
MQ	
Luan Heimlich Electrical Engineering	LEGO Challenge Day - FLL Resources Technical advice re LEGO Robots Liaison with initiator of Guinness World Record FLL and FRC members to support Bootcamp workshops.
Sarah Heimlich First LEGO League tutor, First Robotics Team member	LEGO Challenge Day - Technical advice re LEGO Robots Worked with FRC members to lead three Bootcamps. Tutoring and mentoring of Woodenbong HS via VC
Kate Highfield Institute of Early Childhood	Foundation member of the project Academic research support
DEC	
Angela Churchland	**Bootcamp workshop leadership on SYTYRCD**
Technology Providers	
RM Asia-Pacific	Ongoing access to new resources suitable for MacICT's Bee-Bots, Pro-Bots and Ed-e
Sandra Googan LEGO Australia	Resources for LEGO Robotics Challenge Day
Joanna Bell Modern Teaching Aids	Resources – LEGO Robots Workshop leadership on SYTYRCD
John Burfoot Moore Education	Workshop leadership on SYTYRCD
Conferences	
Inspire Innovate ICT Conference. South West Sydney Region	Blogging about the 'Bots' Workshop - Kate Highfield, Sue Fennell Described the 2010 project with K-2 teachers and students and offered participation in 2011 project. Target audience: K-2 & Preschool
SMART Teachers Conference 'See, Share & Shape the Future'	MacICT's Robotics Projects in 2010-11

Appendix I: Publications

Education TODAY The magazine for Education Professionals Issue 10 October 2010
http://www.minnisjournals.com.au/educationtoday/articles.php?articleid=824

AUSTRALIA & NEW ZEALAND SCHOOLS BLOG RM Education Posted 11 March 2011
Mitchell High School wins Australian National Robotics Ed-e Competition (Teacher trained at MacICT in 2010)
http://rmeducationblogs.com/aus-nz-schools/mitchell-high-school-wins-australian-national-robotics-ed-e-competition/

Early Childhood News with ece.edna.edu.au Online Professional Networking // Bee-Bots
http://www.edna.edu.au/edna/webdav/site/myjahiasite/shared/ece/ece%20newsletter/ECE_110331.html

Macquarie University Australian Centre for Education Submission to the Inquiry into Teacher Education
http://www.aph.gov.au/house/committee/evt/teachereduc/subs/sub130.pdf

ICT for Teaching & Learning in Falkirk Primary Schools Bee-Bot to Logo – engaging the primary mathematician
https://blogs.glowscotland.org.uk/fa/ICTFalkirkPrimaries/2011/04/20/Bee-Bot-to-logo/

TTS Group (UK) tweet 4 June 2011 (TTS have 484 followers)
A 3D Bee-Bot Mat – great idea! http://myBee-Bot.wordpress.com/2011/06/02/3d-Bee-Bot-mat/

Bee-Bots Inspire Innovate 2011 Prezi for Innovate Inspire Conference March 2011 South West Sydney region
http://prezi.com/q3yaktd0wett/bee-bots-inspire-innovate-2011/

References

Anderson, T., & Dron, J. (2010). Three generations of distance education pedagogy. The International Review Of Research In Open And Distance Learning, 12(3), 80-97. Retrieved from http://www.irrodl.org/index.php/irrodl/article/view/890/1826

Broadhead, P. (2004). Early years play and learning: Developing social skills and cooperation. London: RoutledgeFalmer.

Broadhead, P. (2006). Developing an understanding of young children's learning through play: The place of observation, interaction and reflection. British Educational Research Journal 32, no. 2: 191–207.

Healy, L. (2008). Charting the microworld territory: the placing of theoretical signposts, The First Century of the International Commission on Mathematical Instruction (1908-2008) Reflecting and Shaping the World of Mathematics Education retrieved from http://www.unige.ch/math/EnsMath/Rome2008/WG4/Papers/HEALY.pdf

Highfield, K. & Goodwin, K. (2008) A Review of Recent Research in Early Mathematics Learning and Technology. In M. Goos, R. Brown & K. Makar (Eds.) Navigating Currents and Charting Directions (Proceedings of the 31st Annual Conference of the Mathematics Education Research Group of Australasia) Vol. 1 pp 259 - 264. Adelaide; MERGA.

Highfield, K. (2010) Robotic toys as a catalyst for mathematical problem solving. Australian Primary Mathematics Classroom 15 (2) pp.22 – 27.

Janka, P. (2008). Using a programmable toy at preschool age: Why and how? In S. Carpin, I. Noda, E. Pagello, M. Reggiani & O. Stryk (Eds.), Simulation, Modeling, and Programming for Autonomous Robots. First International Conference, SIMPAR 2008 Venice, Italy, 3-7 November, 2008. Proceedings, pp.112-121. Berlin, Germany: Springer. Retrieved from https://www.di.unito.it/~barbara/WorkVenezia3nov08/TeachingWithRobotics/pekarova.pdf

Pappert, S. (1980). Mindstorms: children, computers and powerful ideas. Brighton: Harvester Press

Yin, R.(2009) Case Study Research: Design and Methods. Fourth Edition. California SAGE Publications.

Education Week Digital Directions. (June 29, 2010). Making Tech Use (Early) Elementary

http://blogs.edweek.org/edweek/DigitalEducation/

Tarte, J. (2011) The value of a PLN Connected Principals Posted by Justin Tarte on 6/30/11 Best Educational Practices,Distributed Leadership,Leadership Essentials,Networked Learning,Professional Development

Pickett, A. (2011) Does it take more time to teach online?
http://etap640.edublogs.org/2011/10/03/does-it-take-more-time-to-teach-online/

Lenhart,A., Madden, M., Smith,A., Purcell,K., Zickuhr,K., Rainie, L., (2011) Teens, kindness and cruelty on social network sites Posted Nov 9, 2011
http://www.pewinternet.org/Reports/2011/Teens-and-social-media/Part-4/Dos-and-donts-of-online-behavior.aspx