COMPUTER EDUCATION GROUP OF VICTORIA

The Victorian Information Technology Teachers Association Inc.
supporting ICT educators

ICT in Education Victoria
Professional Teachers' Association

5.1

DLTV JOURNAL

The Journal of Digital Learning and Teaching Victoria

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Digital Learning and Teaching Victoria

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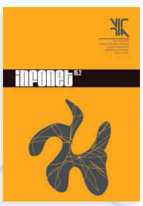
Front cover of COM 3 Journal, Issue No. 17, Computer Education Group of Victoria, Nov 1979.



Front cover of Infonet, The Journal of the Victorian Information Technology Teachers Association Inc. Volume 15, Victorian Information Technology Teachers Association Number 2005

Front cover of ICT in Education Journal, Vol. 32, No. 1, ICT in Education Victoria, Carlton, June 2009

DLTV Journal
The Journal of Digital Learning and Teaching Victoria

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Editorial

Pennie White and Roland Gesthuizen
Faculty of Education, Monash University

We are pleased to present Volume 5.1 of the DLTV journal in the year of the 40th anniversary of our teacher association.

The President's report in this issue is really The Presidents' Report because it is a joint effort from our outgoing President Mel Cashen and our incoming President Ben Gallagher. We thank Mel for her continuing contribution and welcome Ben into his new role.

We pay tribute to Mark Richardson and we extend our deepest sympathy to his family and all those who had the pleasure to know him. There is an article in this issue to acknowledge and celebrate the contribution that Mark has made in our technology in education community.

In this edition we have created a new section called Bits and Bytes to encourage short contributions from our readers. Thank you to our first contributors for their bits and bytes on VCE programming languages, mind mapping and STEM spaces. We heartily welcome contributions of a paragraph to a page from our readers for future editions.

We open our Time Capsule to reshare an article first published in 2000 by Anne McDougall and Barry McCrae. This details the inception and evolution of our Victorian subject association from 1978 to 2000. This history helps us to understand the change and challenges that swept across our schools.

The report by Ben Marr explores how Gamemaker fostered the development of students' creative problem-solving skills at Scotch College Junior School. It is interesting to consider the new products created by these students when they program their own computer games in a challenging environment that that encourages risk taking, cooperative endeavour, competition and challenge.

The article contributed by Clark Burt, called Using Robots and DigiTech for students with disabilities explores the use of Cozmo, the friendly robot with AI capability. Clark offers a theoretically embedded discussion of pedagogical implications surrounding the use of Cozmo as well as clear links to the Digital Technologies Curriculum.

We are connected globally to an international network of educators through our association with the International Society for Technology in Education (ISTE). We appreciate our agreement with ISTE to reprint their articles sourced internationally. In this issue we offer the following two interesting ISTE reports. Tim Douglas explores how flexible learning spaces help students to be productive, comfortable and unpacks an important question; do they actually improve learning? Janice Mak, reveals 3 powerful words that can unlock computer science success. Enjoy the artwork with this piece.

Nathan Alison shares a Book Review "Invent To Learn: Making, Tinkering, and Engineering in the Classroom by Sylvia Libow Martinez, Gary Stager. This is an interesting text that not only advocates for maker learning experiences in schools, but makes a case for what is needed to build a culture where maker teaching and learning can happen.

At the close of the ACCE2018 conference in Sydney, the DLTV was given an opportunity to celebrate and showcase our proud history spanning four decades of teaching and learning digital technologies in education with a stage show themed around Back to the Future. Keep an eye out for our next national conference; ACCE2020 in Melbourne.

We welcome your contributions to the DLTV journal. Some themes that might be of particular interest to our readership are STEM, coding and the VCE curriculum. Please email us and share your ideas for an article for an upcoming issue.

Matthew Harrison, Amanda Rablin and Roland Gesthuizen with the Delorean that they transported to Sydney for the ACCE Conference

From the President

Ben Gallagher

This year sees DLTV and all of its members celebrate a special milestone of 40 years since the first meeting of one of our antecedent organisations. If we consider how far things have come just in the last few years it is hard to imagine what it was like 40 years ago in 1978.

On May 1st, 1978, a number of interested people joined together and formed the Computer Educator Group of Victoria. The first CEGV conference was held in 1979 at LaTrobe University and continued annually. You can find out more about the history of the CEGV in our special reprinted article From CEGV 1979 to ACEC 2000: Australian computers in education conferences come of age by Anne MacDougall and Barry McCrae.

The next two years promise to be an exciting time as we continue the work of those involved with CEGV, the Victorian Information Technology Teachers Association (VITTA) and ICT in Education Victoria (ICTEV). Next year at DigiCon19 we will celebrate the 40th anniversary of the first CEGV conference, and then in 2020 we are proud to be hosting the national conference of the Australian Council for Computers in Education (ACCE2020).

In Victoria we are very appreciative of the exceptional work that has taken place in Digital Learning and Teaching and it makes us extremely proud to have been part of this for the last 40 years. Victoria leads the way in Digital Learning, and around the world people look to our classrooms and the stories of global connections, innovation and experiences our students are having with Digital Technologies.

Throughout the implementation of the new Digital Technologies Curriculum we have seen schools across Victoria build their knowledge through professional learning and implement world class learning for their students. These students are not only exploring the content of digital technologies but exploring real world issues and problems through real world contexts. From robotics and coding to preparing data and analysing software designs teachers from Foundation to VCE have shown commitment to developing the life long learners they teach.

At DLTV we are committed to supporting teachers as they make a difference in all children's lives. Our website is regularly updated with resources and articles and is complimented by our regular DLTV newsletters sharing opportunities for teachers and stories from our members. The DLTV journal and podcasts feature articles and interviews with experts including classroom teachers and academics exploring the innovative teaching ideas.

None of this can be done without the support of our Committee of Management who have volunteered their time to make DLTV what it is today. It is fitting that in our 40th year we were able to recognise the contribution of two people who have made an indelible difference to our organisation. At DigiCon18 Roland Gesthuizen and Donna Gronn received receive life memberships after decades of service to the education technology community.

Donna Gronn, Senior Lecturer (ICT Education) at Australian Catholic University, joined the Committee of Management of the Computer Education Group of Victoria (CEGV) after the ACCE 2000 Melbourne national conference. Over the following 18 years she has provided an outstanding service to the Victorian education community through her work with the ICT in Education Victoria (ICTEV, former CEGV). During that time Donna was involved in the development of the Australian Curriculum: Digital Technologies and represented Victoria at the Australian Council for Computers in Education (ACCE).

Donna oversaw possibly the biggest event to happen in Victorian computing in education when she oversaw the union of the ICTEV and VITTA to create the DLTV subject association. As the ICTEV President, Donna was re-elected as inaugural DLTV President and oversaw the successful formation of the new association. In 2017 Donna stepped down from the committee of management but such is her passion that she has stayed on as a very valuable member of the DigiCon organising committee.

Roland Gesthuizen, STEM Method Lecturer & Professional Practice Consultant at Monash University joined the Computer Education Group of Victoria (CEGV) back in 1993 following an invitation at a National Conference to lend a hand. He hasn't stopped since.

Roland has been a continuous committee member of various computing groups such as CEGV, VITTA, ICTEV & DLTV, representing 25 years of service to the community. Roland has been a regular author of our professional journals, is the current co-editor of this publication, and has shared his knowledge in workshops, webinars and professional learning events over the years.

Both Roland and Donna were there in 2014 when ICTEV and VITTA merged to become the Digital Learning and Teaching we know today. We are looking forward to taking a look back over the past 40 years through our celebrations this year and next, and considering how we will be part of the Victorian education community for the next 40 years and beyond.

Melinda Cashen
DLTV Past President
May 2015 – May 2018

Ben Gallagher
DLTV President
May 2018 –

Vale

MARK RICHARDSON

It is with heavy hearts that we share the news of Mark Richardson's passing with our DLTV community.

Mark has had a long standing relationship with ICTEV, VITTA, DLTV, and the digital education community. He was originally a Primary Teacher and ICT Coordinator with a passion for digital technologies and tools to enhance learning. He moved into consulting as ICTEd Services and shared his expertise as a professional learning planner, presenter and consultant, spending 2009 as VITTA's Professional Learning Coordinator.

Mark was always present at conferences, sharing the new gadget he had found or discussing learning space design in his calm and gentle manner. He was easily approachable and delegates lined up to get into his sessions where they knew they were guaranteed to walk away with a toolkit of new ideas.

He was always willing to share his knowledge and experiences of how he used digital technologies to support student learning. He is fondly remembered by DLTV members for his presentation on how he designed an immersive space where students could engage in creativity with digital technologies in a historic building, proving the breadth of his research and expertise.

It was this fondness for professional learning and sharing that drew Mark to DLTV in 2014 as the Professional Learning Manager at the newly merged organisation. In this role he was straight to work with ideas of improving professional learning opportunities for rural and regional teachers and to designing professional learning around the needs of the members.

He jumped into the role with vigor. Mark was instrumental in starting conferences for regional centres when anyone else would still finding their feet in the position.

Mark also had a passion for learning and tinkering, which is where his commitment to Maker Faire and his instrumental partnership with the DET during their Mini Maker Faire evolved. If anyone ran into Mark at the faire they were sure to see him grinning ear to ear as he was excited to see new tools and so proud of what people were sharing.

In the lead up to the Maker Faire Event, Mark committed his time to a series of webinars, a passion of his that will continue on for DLTV. Mark could see the potential for the use of webinars as professional learning, especially for those in rural and remote regions, before it was second nature like it is today. He researched how to present effectively online, talked to members about their needs and started DLTV's first webinar series, which is still relevant to teachers years later.

The Committee of Management were privileged to work closely with such a dedicated colleague and Mark's kind heart and clear vision will certainly be remembered. He was always quick to lend a hand and even after he had left DLTV he would check in to see if there was anything he could help out with.

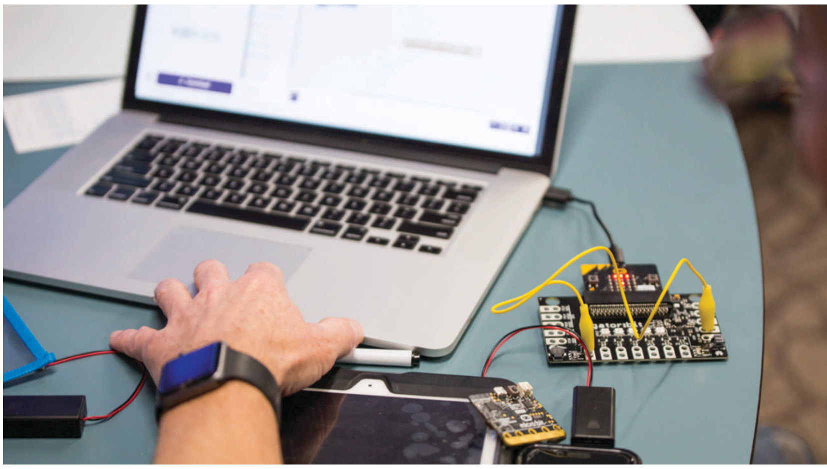
But it isn't just DLTV members who had the privilege to work with Mark. He was always seen at TeachMeets and IT events across Melbourne, supporting presenters and giving up his time to share his expertise. Mark was always sharing an article or provoking us with questions on Twitter and across a variety of platforms.

It doesn't seem that long ago that Mark stepped away from DLTV to pursue his other love, street photography. And with the same passion Mark had for ICT he put into his remarkable photos, sharing stories behind the glasses and allowing us a glimpse of what it was like to look through the eyes of Mark, the jazz loving, kind hearted man we all respected.

Mark, unbelievably committed and always gentlemanly, will be missed in the Digital Learning community and our thoughts are with Kim, Tess, Hannah and family.

Melinda Cashen

DIGICON18 AND THE DLTV AWARDS



John Pearce (left) received the prestigious Making IT Happen award

Bec Spink – Outstanding Leader of the Year

Linda Liukas captivated the crowd with a magical journey

DigiCon is always one of the highlights of the DLTV year and DigiCon18 was no exception. Held at the Australian Catholic University in Fitzroy, DigiCon18 saw more than 250 educators working together to share the best in digital learning.

The conference was kicked off with a keynote by Rafranz Davis, winner of ISTE's Outstanding Leadership Award in 2017. Rafranz charted her journey from a small town in Texas and explored the power of technology to change our lives and connect us. Chris Harte also explored this theme in his keynote as he looked at how digital technologies can be relevant across the curriculum.

During DigiCon18 there were more than 60 breakout sessions across many streams, with educators and students from all levels sharing their craft. There were plenty of hands on sessions and case studies of great practice.

On Friday the delegates heard from Luke Pearson, founder of IndigenousX. Luke took us from his time as a teacher through the process of creating a platform that amplifies the voices of the first peoples across the country. The conference closed with a magical journey from Linda Liukas, author of the Hello Ruby books.

The conference also saw four educators receiving DLTV Awards. dltv.vic.edu.au/Awards These awards acknowledge Victorian educators who contribute to promoting digital learning and teaching, using technology to the educational advancement of their students and have a significant positive effect on colleagues across Victoria. The awardees for 2018 were:

DLTV Outstanding Educator of the Year – Steve Allen

Steve is a passionate supporter of Digital Technologies in supporting student learning. He launched the specialist Makerspace at Glenroy West Primary School, while being involved in Numeracy support, Science and classroom teaching. Steve has been a VCAA Specialist Teacher since 2016 and was involved in writing sample units, teacher resources and professional development programs. Steve now teaches as a Digital Learning Specialist Teacher at Epping Views Primary School.

Ben Gallagher Conference Convenor

Rafranz Davis kicked off DigiCon18 with a personal exploration of the power of technology

Natalie Heath – Maggie Iaquinto VCE Computing Educator of the Year

Marcus Mulcahy – Digital Technologies Educator of the Year

Steve Allen – DLTV Outstanding Educator of the Year

DLTV Outstanding Leader of the Year – Bec Spink

Bec is the Assistant Principal of Aitken Primary School and is a co-founder of Code the Future, an award winning not for profit organisation that connects schools and teachers with the technology industry to empower children to solve real world problems through learning to code. She has served as a member of the DLTV Committee of Management in the past, taking on roles such as Vice President and Conference Chair of DigiCON.

Maggie Iaquinto VCE Computing Educator of the Year – Natalie Heath

Natalie has been a great supporter of VCE computing teachers. Natalie presented at this year's VCE Computing Day and at DigiCon18, and her experience and advice is invaluable. Natalie has also helped students and teachers as a creator of resources such as practice exams. She is a humble but generous member of the community and a deserved recipient of the award named in Maggie's honour.

Digital Technologies Educator of the Year – Marcus Mulcahy

Marcus is passionate about ensuring our younger generation of students has access to digital technologies and skill development. He is currently working as a Learning Specialist at Carrum Primary School where he developed Radio Carrum. His work with students and Radio Carrum has been well recognised and he was the recipient of of a Churchill Fellowship in 2017 that allowed him to travel to the US to continue his research on makerspaces in school.

Another prestigious award was given out to a very deserving recipient. John Pearce has been a long time supporter of digital learning in Victoria and his contribution was recognised with the ISTE Making IT Happen Award. It is deserved recognition for an educator who has been ever present at our conferences and professional learning events.

Plans for DigiCon19 and the ACCE 2020 Conference are already well underway, so make sure you keep an eye out for news of dates and venues. We hope to see many of you taking part at DigiCon next year.

BITS AND BYTES

Correspondence, conversation starters and short thoughts from our community.
If you have something to contribute please email the editors at publications@dltv.vic.edu.au

VCE Programming Language Options to Consider

By Maria-Ana Sanchez

Which programming language should we teach and why? This is the typical question teachers face when selecting a language for their Digital Technologies and Software Development curriculum. After reading a few articles and viewing some talks by experts online, I can say these languages are worth to consider teaching in 2019 and beyond: Python, Java, Swift and Java Script. These languages are not in any order.

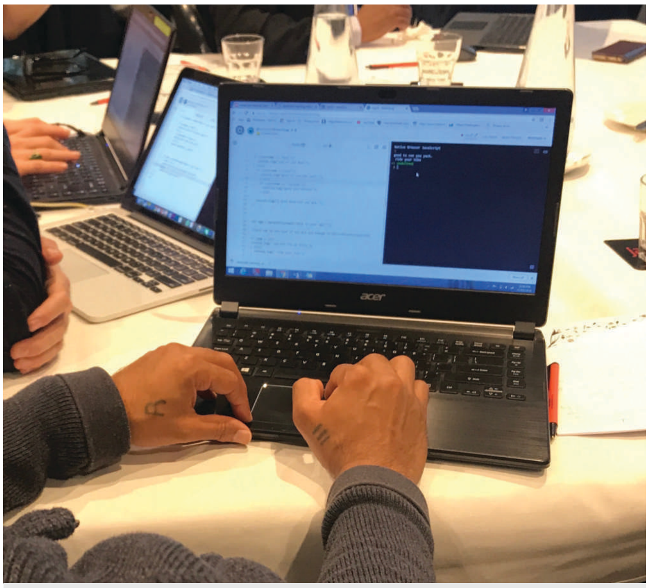
Python has proven to be an easy language to introduce programming. Its syntax is simple and easy to read, and it is newer than a lot of other languages. Python is a powerful language used in computer science, machine learning and data analysis. Furthermore, the demand for Python programmers is high. GrokLearning offers numerous Python courses catering for different age groups and skills.

Java, on the other hand, is very popular for creating programs with real world applications. It is easy to learn as it has an English-like syntax, with helpful open source tools and libraries. It makes use of Netbeans and Eclipse, two powerful IDEs that have taken Java to the next level. We can find Java on mobiles, desktops and large scale applications.

Swift is also one of the most popular programming languages which is used for building iOS apps. Apple designed this language with a focus on the education market and consumers. Swift is a powerful but easy to learn language. It is open source and it has a strong community always ready to help.

Java Script, along with HTML and CSS, is used for building interactive websites. JavaScript is an essential technology for web development, mobile apps and game development. Therefore, it is a significant language to consider. Students can code it in the browser as there is no need for a development environment.

It is important that students immerse themselves in programming and understand the logic of it. Once they learn the essential programming concepts such as variables, data structures, functions and control structures, they will realise that they can apply these principles to all other languages.



Many programming languages can be utilised within a browser

You could say it does not matter what language we teach and learn at school if students are developing critical thinking and problem-solving skills. However, it is important to consider languages that relate to latest technology advances such as Robotics and Artificial Intelligence, that are taught in tertiary institutions and that have high demands in the IT industry. Any language is challenging, fun and worthwhile to learn.

Mind Mapping with VCE Software Development

By Chris Paragreen

I have long encouraged my students to make something like a mind map to help them make sense of things, but after seeing several poor attempts and many no-attempts, I thought it best that I make a mind map for myself so that I could model to my students what they should be attempting.

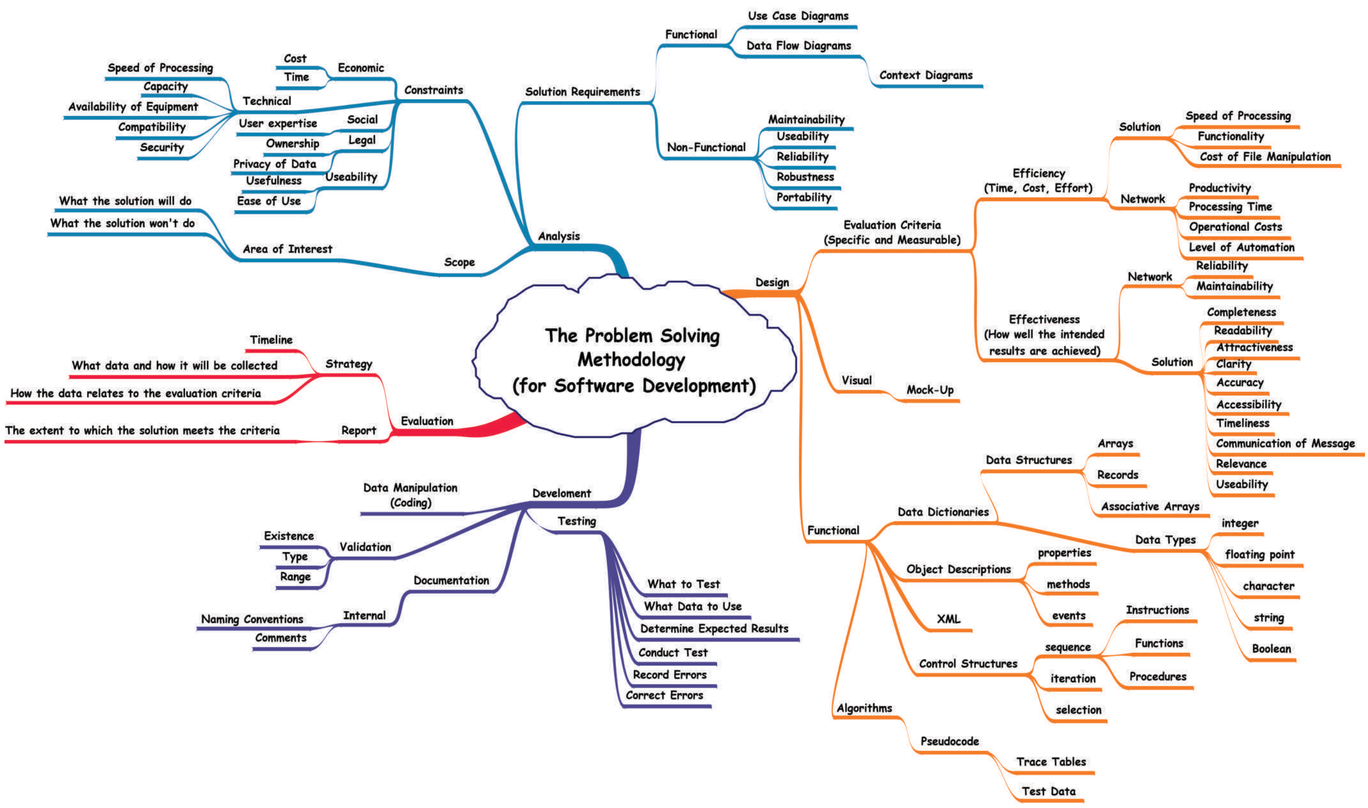
Below you can see a mind map I developed as part of the process covered in the problem solving methodology of the VCE SD Course. My reasoning for this was:

- to get my head around what I should and shouldn't be teaching
- to encourage my students to make sense of the bevy of terms at various places in the study design.

It's important to note that making this mind map is not something I give to my students, as I think it's better for their understanding to create one for themselves.

There are 3 sections in the study design that need to be synthesised. Firstly, and most importantly, are the key knowledge and key skills described in each area of study. The points in these sections are further refined by referring to the glossary and to the overarching description of the Problem Solving Methodology. Therein lies a source of confusion for teachers and students alike, because the latter two sections describe content for all of Computing, Informatics and Software Development. Each subject does not need to know all of it.

My mind map (in its current form) is not intended to cover the entire Software Development course. Rather, it is meant to clarify those sections of the PSM that relate specifically to Software Development. But it does take a lot of text and summarise it in a visual form. Perhaps it should be a task for students of Unit 2 Computing.



The Problem Solving Methodology for Software Development

Starting a STEM Space

By Celeste Pettinella, Doncaster Primary School

Firstly, what is a STEM space?

In simple terms, this is a room at our school that allows STEM (Science, Technology, Engineering and Mathematics) to take place for our students. This space is where one of these disciplines can take place or the integration of these disciplines can be housed. To begin the journey for creating a STEM space at Doncaster Primary School, I first asked my principal and assistant principal where it could be located. I was excited to put theory into practice and share this wonderful idea with my students, teaching colleagues, the wider community and university lecturers.

It began as a blank classroom with minimal resources. The DLTV kindly visited to look at the room offered to me and gave me suggestions. Later I searched Pinterest for inspiration and after six months of tinkering the space starting taking shape. Alisha, a teaching colleague designed floor plans and volunteered her time to create a masterpiece.

After six months it has transformed to host state of the art furniture and computers. We slowly built up the room with the latest technology tools and kits. It is now a colourful teaching and learning area where students can engage with 21C learning and problem solving. As the PLC coordinator, I allowed the STEM PLC team to decide upon a name. Whilst a Makerspaces was an option we decided STEM Space.

The set up of the space took a while. We used a consultant for ideas about innovative furniture options. Furniture to unwrap, tables to wipe, floors to be swept, pin boards to be dressed and some furniture to be assembled. A huge thank you to my supportive family for assisting as well as some colleagues.

I am very grateful that I have been able to network with the DLTV and Monash University.

We created a STEM timetable to schedule other classes to access and use the space. The space is now also used by our after-school STEM club. In addition, we have hosted special events such as the STEM EXPO. Roland visited us to show our students some of the latest technology including 360 cameras, makey makey, robots and virtual glasses.

The space at our school is evolving and whilst it is not 100% complete it is certainly a step in the right direction. Whilst designing a STEM space was challenging, there was no turning back once we had it up and running.

TIME CAPSULE

REFLECTING ON AND COMMEMORATING OUR PAST

This year marks the 40th Anniversary of the formation of the first computer education group in Victoria. Computer Education Group of Victoria was formed in 1978 and was the fore-runner for Digital Learning and Teaching Victoria.

To commemorate this anniversary we republish an article from 2000 by two of the founding members of CEGV, Barry McRae and Anne McDougall. In future editions we will explore the more recent history of computer education groups in Victoria.

Reprint: McDougall, Anne & McCrae, Barry. (2000). From CEGV 1979 to ACEC 2000: Australian computers in education conferences come of age. *Australian Educational Computing. 15(1), pp. 3-6.*

From CEGV 1979 to ACEC 2000: Australian computers in education conferences come of age

Anne McDougall & Barry McCrae

This paper describes the events leading to the formation of the Computer Education Group of Victoria and its organisation of the first "national" computers in education conference in 1979. It outlines the establishment of the National Committee for Computers in Education (now the Australian Council for Computers in Education), and looks at the series of Australian Computers in Education Conferences which have been hosted by six of the eight states and territories throughout the following 21 years, commenting on their significance in the development of educational computing in this country.

Schools' computing in Victoria in the 1970's

In Victoria during the mid and late 1970's there was a growing interest in schools in the use of computers for both teaching and administration. Few schools actually had computers, but some had access to mini or mainframe machines in tertiary institutions. Monash University developed a system, MONECS, using mark-sensed cards which enabled students to program, initially in FORTRAN and later in COBOL, BASIC and Pascal. Teachers would collect students' programs, deliver them to the university to be run during quiet times overnight, and pick them up on the way to school the following morning.

A "computing option" had been available within the Victorian Year 12 General Mathematics course since the mid 1970's. The course gained popularity, and by 1979 was offered at many schools, though often students drew flowcharts without ever running the programs they represented, or ran interactive processes on calculators as they did not have adequate access to real computers. Larkin (1979, p.10) expressed concern that "the subject is now being taught by computer amateurs who,

One of the aims on the newly formed group was to continue the publication of the COM 3 journal

although keen, may not necessarily have a strong computer science background". He described problems with interpretation of the syllabus and difficulties associated with the absence of a suitable practical manual for the subject.

During 1978 work was proceeding on a new Year 12 H.S.C. subject, Computer Science. The course was approved for implementation to start in 1981. Textbooks were written to assist in teaching the subject (Mongomery & Juliff, 1981; Woodhouse, Johnstone & McDougall, 1982); all but one of the authors were university academics. It was at that time quite unclear where schools were to find teachers with adequate qualifications and experience to teach the subject.

The advent of microcomputers, developed in the U.S.A. in the early 1970's and available in this country at the end of the decade, meant that schools could now obtain computers of their own; this happened in an essentially unplanned way in Victoria. Walker (1991) quotes Bill Bainbridge, then a senior bureaucrat in the Victorian Department of Education, comparing the situation in 1979 in this state very unfavourably with those in South Australia and Tasmania at the time.

> *In the early months of 1979 the situation was thus - all technical colleges equipped, and supported by TEAC, some twenty high schools with microcomputers of nine different types; a small group of inspectors of schools trying to spread the gospel; a travelling road show to convince school principals and teachers that the machines don't bite; a small number of highly enthusiastic [sic] and an unknown number of teachers with a variety of relevant experiences and qualifications; and as a looming threat, accreditation by VISE [Victorian Institute of Secondary Education] of the projected Year 12 course in computer studies.*
>
> *(Bainbridge, 1980, cited in Walker, 1991)*

Walker (1991) also provides a description of the first school microcomputer project, begun by two science teachers, Greg Johnstone and Tim Mowchanuk, at Essendon Grammar School, on a Commonwealth Schools Commission Innovations Program grant in late 1976.

> *In early 1976, Mowchanuk had imported an Altair 8800, one of the first available microcomputers, for his own use. Subsequently the two teachers applied for and received a Commonwealth Schools Commission Innovation Program grant to develop their interest in microcomputers into an educational initiative in the school in which they both worked. The funded project required them to undertake a number of activities. First, they were to locate hardware suitable for use in the school. Secondly, they were to produce software, practically all of which had, in the beginning, to be written personally. Finally, they were required to publish a newsletter to promulgate their activities. This newsletter was called COM-3 (standing for Computer Community Communications) and edited by Mowchanuk. ...The first issues appeared in August 1977. By May 1978 COM-3 circulated to approximately 400 personal and educational microcomputer users in Australia and New Zealand.*
>
> *(Walker, 1991, p. 296)*

COMPUTER EDUCATION GROUP OF VICTORIA

The CEGV and the first "national" conference – 1979

In 1978 Barry McCrae, a lecturer at Melbourne College of Advanced Education, who had recently been in the United Kingdom and observed the activities of the British Computer Education Group, saw a need for a similar organisation in Victoria. He approached Johnstone and Mowchanuk about using COM-3 as the journal for such a group. Then he called a public meeting, with the support of the Mathematical Association of Victoria (MAV), to consider formation of a Computer Education Group. Part of the text of the announcement of the meeting, a typed foolscap sheet, was as follows.

Special announcement

A meeting will be held at the National Science Centre, 191 Royal Parade, Parkville (Melbourne) on Monday, May 1 at 7.45 pm.

The purpose of this meeting will be to establish the Computer Education Group of Australia (CEGA). Business will include the election of an Executive to hold office until the first general meeting of the Group. It is intended that the principal object of the CEGA will be to promote computer education in Australia and that this object will be pursued by:

(i) publishing a regular journal (5 issues/year) - COM-3 in a glossy format and edited by Tim Mowchanuk;

(ii) distribution of a regular newsletter to members (5 issues per year), "Interrupt" (previously produced by MAV) of 4 photocopied pages;

(iii) conducting of biennial conferences - 1st conference: Melbourne, May 1979;

(iv) publishing and selling collections of articles in the general field of computer education ;

(v) establishing local groups throughout Australia which will meet regularly and run in-service education activities from time to time;

(vi) acting as a clearing house for information concerning computer education.

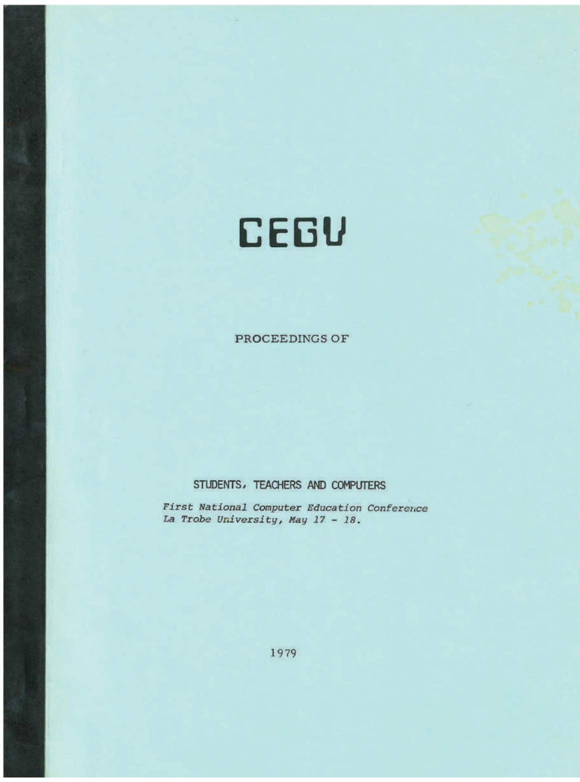
There are two particular points to note here. Firstly, the initial idea was in fact to establish a national association for computer educators. And secondly, the importance attributed from the outset to the role of conferences is clear from its inclusion in the list of activities proposed in this first announcement.

McCrae expected perhaps 20 people to come to the meeting (McCrae, 1979); in the event about 100 attended. The attention of the meeting was drawn to the possibility that similar groups might already exist in other states, perhaps associated with established schools' computing centres in Tasmania, South Australia and Western Australia, and it was decide that this Group should, at least in the first instance, be a Victorian one. A Working Committee was elected, to be convened by McCrae, to develop the form that the Computer Education Group of Victoria should take.

At a second meeting, two months later, the establishment of the CEGV was completed. Aims for the Group were agreed, and an Executive was elected: Barbara Marsh was elected Chairperson with Barry McCrae as Co-Chair and Conference Convenor. Membership was set at $10 for individual and organisational members. This meeting also confirmed that a two-day computer education conference would be held on May 17th and 18th 1979, and that interstate speakers would be invited.

Although the CEGV clearly was seen as a state Group, it saw its first conference, in 1979, as a national event, the first of a series of national computer education conferences which would be run in turn by various states. The conference announcement brochure (a foolscap typed page, with hand-lettered heading) included the following: "The conference is only the first of many. Hopefully future conferences will be held in different states." And in a special conference issue of COM-3 Mowchanuk wrote: " ... the Computer Education Conference sponsored by the Computer Education Group of Victoria. ... hopefully will set a pattern of regular conferences hosted by education groups in all States." (Mowchanuk, 1979, p. 6)

The conference was held at La Trobe University in Melbourne on 17-18 May, 1979. The title and theme was Students,



The first CEGV conference was held in 1979 at La Trobe University, Bundoora.

Teachers and Computers. Registration was $15.00, and more than 300 participants attended. An emphasis in the program was on keynote lectures which assessed the state of computer education in the various states, and looked at the likely impact of microcomputers (McCrae, 1979). The keynote speakers were Peter Sandery from the South Australian Education Department, Professor Juris Reinfelds from the University of Wollongong in New South Wales, Sandra Wills from the Elizabeth Computing Centre in Tasmania, David Woodrow from St. Peter's Lutheran College in Queensland, and Dr. Peter Thorne from the University of Melbourne.

The Conference at La Trobe resolved to support the establishment of groups similar to the CEGV in States where they did not currently exist, but deferred consideration of a Computer Education Group of Australia, or affiliation of the state groups with the Australian Computer Society (McCrae, 1979).

Further conferences were run in Melbourne by the CEGV in 1980, 1981 and 1982. The title of the 1980 conference was simply Computers in Education, and again interstate speakers were listed on the program. The 1981 conference saw the introduction of the practice of inviting international keynote speakers; the first was Professor Seymour Papert of the Massachusetts Institute of Technology. One of the authors clearly remembers the conference committee meeting at which it was discovered that this conference, for which the budget and venue were planned for 300 attendees, already had almost 1000 registrations! The 1982 conference featured Professor Jim Howe from the University of Edinburgh as the international keynote. Although it appears that the word "national" was dropped from the titles of these conferences, they continued to include speakers from interstate, and they attracted interstate attendees.

A national umbrella for computer education groups – the ACCE

The fore-runner of the Australian Council for Computers in Education, the National Committee for Computers in Education (NCCE), was first established as a result of initiatives of some members of the Australian Computer Society (ACS), in particular Dr. Ian Pirie, Professor Arthur Sale and Sandra Wills. The idea was proposed at an informal meeting with members of state and territory Computer Education Groups at the 9th ACS Australian Computer Conference in Hobart in 1982 (Adams, 1986; Freeman, 2000).

Ian Pirie, the ACS Education representative, was a key advocate for the establishment of a national professional association to represent and support the specific area of information technology in education. Following the Hobart meeting, he convened a meeting in Wollongong in December 1982 for representatives from each of the state organisations. By the end of two days of solid discussion, debate and negotiation, it was resolved to establish the NCCE (Vogler & Wills, 2000). The national group was developed to lobby government, support state groups and undertake projects nationally, to develop statements of national significance, and take a leadership role in helping systems and groups understand learning technology in education

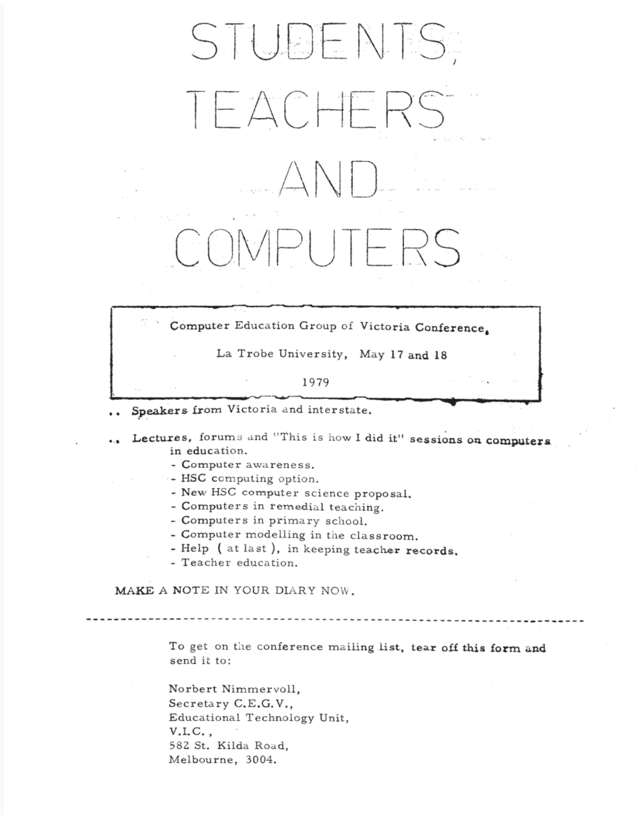
(Williams, 2000).

The first official Australian Computers in Education Conference (ACEC) was held in 1983, hosted on behalf of the NCCE by the CEGV, again at LaTrobe University in Melbourne. International keynote speakers included Professor David Moursund from the University of Oregon, David Squires from Chelsea College, London, and Don Rawitsch from the Minnesota Educational Computing Consortium. Professor R. Preston Rank from the Massachusetts Institute of Technology (aka. professional speechmaker Campbell McComas) entertained attendees at the conference dinner.

A formal statement in the Proceedings of the 1983 conference, by the inaugural Chairperson of the NCCE, states:

> The N.C.C.E. intends to arrange an annual national computer education conference, the venue rotating among the states and territories. The present conference, hosted by the Computer Education Group of Victoria, is the first of these national conferences. At each national conference the N.C.C.E. will meet, and the host state for the next year will be decided.
>
> (McDougall, 1983, p. 93)

At the 1985 conference it was decided that the organisation should be formalised. In November of that year, a meeting of Computer Education Group state presidents was held in Melbourne, and a number of fundamental decisions were made. A constitution was formulated, a secretariat was established, and the Committee took on a new name: the Australian Council for Computers in Education (ACCE). The meeting also decided to establish a national journal, Australian Educational Computing, under an editorial board (Adams, 1986; Freeman, 2000) .


STUDENTS, TEACHERS AND COMPUTERS

Computer Education Group of Victoria Conference,

La Trobe University, May 17 and 18

1979

.. Speakers from Victoria and interstate.

.. Lectures, forums and "This is how I did it" sessions on computers in education.
- Computer awareness.
- HSC computing option.
- New HSC computer science proposal.
- Computers in remedial teaching.
- Computers in primary school.
- Computer modelling in the classroom.
- Help (at last), in keeping teacher records.
- Teacher education.

MAKE A NOTE IN YOUR DIARY NOW.

To get on the conference mailing list, tear off this form and send it to:

Norbert Nimmervoll,
Secretary C.E.G.V.,
Educational Technology Unit,
V.I.C.,
582 St. Kilda Road,
Melbourne, 3004.

Registration for the first conference was $15.00, and more than 300 participants attended

Australian computers in education conferences 1983 – 2000

The planned series of Australian Computers in Education Conferences has stretched now over 21 years, annually until 1996, and more recently biennially. The following list of host Computer Education Groups, and corresponding conference themes, shows that six of the eight states and territories have hosted ACECs. And at the time of writing, the seventh is expected to become involved in 2002, with a return to Tasmania where the initial meeting about the NCCE took place.

1979	CEGV - Students, Teachers and Computers (First "national" conference) 1983 - CEGV - Could You Use a Computer? (First official ACEC)
1984	CEGNSW - Computers in Education: Dreams and Reality 1985 - CEGQ - The Information Edge: The Future for Educational Computing
1986	CEGV - Computers in Education: On the Crest of a Wave?
1987	CEGSA - Tomorrow's Technology Today
1988	ECAWA - Golden Opportunities
1989	CEGACT - Australian Computer Education Conference
1990	CEGNSW - World Conference on Computers in Education (WCCE90)
1991	CEGQ - Navigating the Nineties
1992	CEGV - Computing the Clever Country?
1993	CEGNSW - Sharing the Vision
1994	CEGQ - Asia-Pacific I.T. in Training & Education Conference (APITITE)
1995	ECAWA - Learning Without Limits
1996	CEGACT - Get with IT 1998 - CEGSA - Australian Computers in Education Conference
2000	CEGV - Learning Technologies, Teaching and the Future of Schools

Throughout the years these conferences have acted as a forum for teachers to exchange information on classroom activities, and to make contact with each other and with experts in the field. They present the current state of educational computing in this country, and provide a forum for the sharing of innovation, ideas and practices in the use of learning technologies. They have proved to be a vital part of the professional development of educational computing practitioners at all levels.

In 1988, one of the authors was invited to edit a special bicentennial issue of Australian Educational Computing, reviewing the national conferences to date. Working through the conferences' proceedings to select papers for reproduction in the journal, she was struck by the extent to which these proceedings provided a comprehensive contemporary history of computing in education in Australia. These national conferences, and the associated proceedings produced by the constituent state and territory groups within the ACCE, are building a valuable record of the development of educational computing in this country.

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How does the use of Gamemaker software foster the development of creative problem – solving skills in boys?

Ben Marr, Scotch College, Melbourne

Abstract

Working individually and collaboratively, twenty-seven Year Five boys created computer games using a program authoring application. The aim of the project was to explore whether the Gamemaker application would foster the development of creative problem-solving skills. Over ten thirty-five minute lessons, boys were introduced to the Gamemaker package and challenged to produce a working computer game that could be played and evaluated by others in the class. Using video evidence, reflective journals and interviews, the study found that when boys construct computer games in a classroom that promotes risk taking, cooperative endeavour, competition and challenge, the process encourages individual and collaborative problem solving, and generates creative products. The use of technology to facilitate learning is well established. In the study, technology was also used to initiate and drive learning, amplifying the role that technology plays in boys'education.

Introduction

Boys in the Scotch College Junior School perform well above State and National averages in tests of literacy and numeracy. In general, these are tests of essential curriculum content and so are key indicators of success in specific learnt skills and with concrete learning scenarios. This study, however, began with the question, "How does the use of Gamemaker software foster the development of creative problem-solving skills in boys?". The evidence collected in various reflective journals and video records tested the hypothesis that if boys constructed their own computer games in a classroom that encouraged risk taking, cooperative endeavour, competition and challenge, they would create new products. These products represented tangible evidence not only of boys' creativity, but also of boys constructing meaning from the interaction with the gaming software and with other boys.

In this research, boys engaged with the software and with each other. They were challenged to find new and innovative ways of constructing the scenarios they put in front of their peers. They needed to explore consequences – action and reaction. In sum, they created a testable, visual experience from the world of their imagination, an experience built not solely on their own ideas, but with the collective ideas of others in the group. To start with, the boys formed a hypothesis (developed an idea for a video game), tested the hypothesis (playing their own and peers' games) and then reflected on their hypothesis (judging their own game via a student journal and interviews). This approach is typical of the protocols used in action research. In addition, action research was chosen as the method of investigation as it imbeds, for both students and the teacher, "the proviso that, if as a teacher I am dissatisfied with what is already going on, I have the confidence and resolution to attempt to change it" (McNiff, 1988, p. 50).

My research project investigated the extent to which boys with a range of academic abilities could articulate and share a variety of problem-solving strategies when working together on the

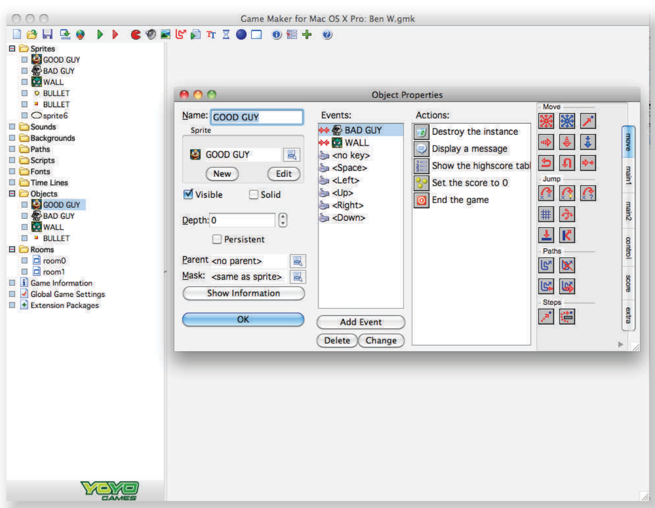

Figure 1: A typical Gamemaker screen with programming options

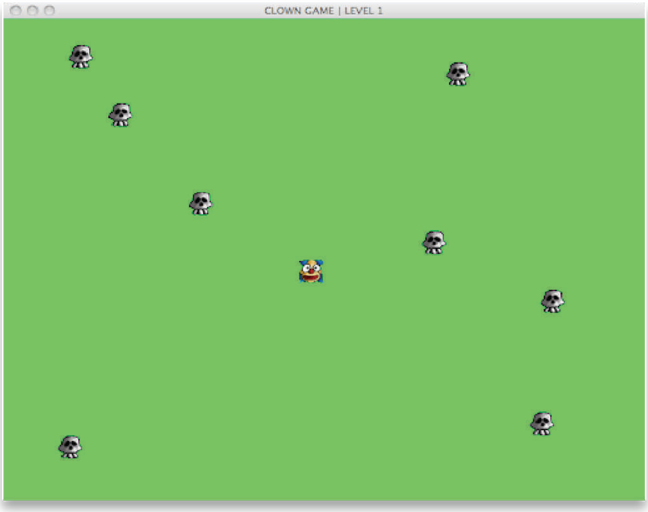

Figure 2: A basic game produced in Gamemaker

Gamemaker computer program. Gamemaker is a program that allows you to create computer games without writing computer code. It allows for drag and drop actions to create games with backgrounds, animated graphics, music and sound effects (see Figure 1). For more experienced game creators, there is a built-in programming language to allow for more sophisticated actions (see Figure 2 for a basic game produced by one of the participants and Figure 3 for a more advanced game produced by a different group of boys).

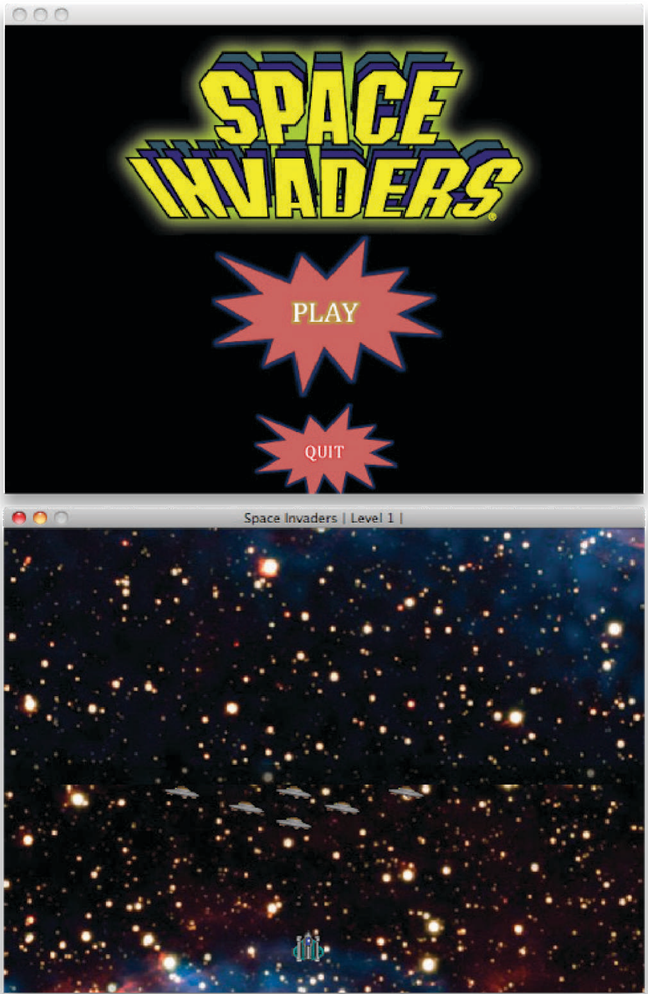

Figure 3: A more sophisticated game with an accompanying title page

Literature Review

There has been much written and spoken about the ways in which schools are killing creativity (Robinson, 2006). There has also been much discussion regarding the importance of students being able to learn effective problem-solving strategies, particularly as the problems that the world will face in the future are not necessarily known. This research analysed how the use of programming software, specifically Gamemaker, fosters the development of creative problem solving in boys.

Creativity has been defined from a variety of perspectives. The notion of creativity as the "production of effective novelty" is one that has been espoused by a number of writers (Aldous, 2007). Sir Ken Robinson (2009) has expanded the notion that to be creative, an idea must not only be original, but also have value. Indeed, he furthered the understanding by noting that, "to be creative, you actually have to do something. It involves putting your imagination to work to make something new, to come up with new solutions to problems, even to think of new problems or questions" (p. 67).

Many studies have looked at how creative thought develops in the brain. Aldous (2007) stated that there is evidence that creativity involves oscillating between thinking and feeling and moving between focused and defocused states of attention. It was not envisaged that this research would be able to identify creative thought, but it was hoped that it would be able to see the product of creative endeavour. However, the prime focus was on how creativity is an ability that everyone can develop and which can be fostered in anyone (Ferrari, Cachia & Punie, 2009). Learning in a creative manner, or creative learning, "involves understanding and new awareness, which allows the learner to go beyond notional acquisition, and focuses on thinking skills" (p. iii).

With this in mind, the Gamemaker software was chosen as the medium through which to analyse the development of creative problem-solving skills. As mentioned previously, Gamemaker allows for students to learn fundamental computer programming skills and then design their own games. Proponents for game design as a means to develop thinking skills emerged in the 1970s. Seymour Papert was the founder of the Massachusetts Institute of Technology (MIT) Artificial Intelligence Laboratory, Professor of Media Technology at MIT and creator of Logo, a programming language used by many schools in the 1980s. He noted that:

> It is one thing for a child to play a computer game; it's another thing altogether for a child to build his or her own game. This is where computers' real power as an educational tool lies. …It is in the computer's ability to facilitate and extend children's awesome natural ability and drive to construct, hypothesise, explore, experiment, evaluate, draw conclusions – in short to learn – all by themselves. (Papert, interviewed by Schwartz, 1999)

Papert also discussed how students' disengagement from school could result from it being too easy and, as such, boring. He noted how students, "talk about 'hard fun' and they don't mean it's fun in spite of being hard. They mean it's fun because it's hard". In addition, he stated that, "learning is essentially hard: it happens best when one is deeply engaged in hard and challenging activities" like computer programming (Papert, 1998, p. 88). He also added that programming differentiates learning for students because it allows for students to take charge of the process of learning. The students themselves, like professional game designers, make the important decisions.

In *Minds in Play – Computer Game Design as a Context for Children's Learning*, Yasmin Kafai chose a Year Four class to undertake a computer game design and creation unit. The Year Four students had to use the Logo software to design a game to teach Prep students about fractions. From her extensive analysis, she found that students actually learned about many things by making and playing games. The constructivist approach also allowed for individual styles to develop in game design as gender differences expressed themselves clearly in the choices of game themes and features (Kafai, 1995).

The Gamemaker unit allowed for discussion amongst peers, and between peers and the teacher. A previous unit on Gamemaker revealed that students were just as likely to ask peers as the teacher for advice on computer programming and design. The element of education having a social construct is noted by many educationalists, including Vygotsky (1978), when he defined the zone of proximal development as:

> the distance between the actual development level as determined by independent problem solving and the level of potential development as determined through problem solving under adult guidance, or in collaboration with more capable peers. (p. 86)

It can reasonably be argued that for students to reach their potential, they need a challenging task to facilitate this, echoing Papert's views about learning being essentially hard.

The decision to choose computer game design was a reflection on students' enjoyment in playing computer games. Papert (1996) noted that, "almost all kids find this an exciting thing to do because video games are important in their world. Besides, it is very challenging to make a video game. It leads you to reflect on yourself and interact with others" (p.12). Playing games as a means of educating boys is taking the soft option. Actually teaching programming is taking the hard option – boys were challenged in areas that they would not normally be involved in before or after this research.

In a report prepared for the NSW Department of Education and Training in Australia (2005), the authors identified that boys needed:

- purpose,
- relevance,
- evidence of progress in learning,
- competition,
- variety,
- action,
- to be given responsibility, and
- structure.

As such, the authors echoed the earlier work on boys' education of Biddulph (1998) and Lilico (2000). These eight characteristics of boy-focused education were also embraced in the present study, in particular:

- the use of computer game programming to which the boys could relate and see as purposeful,
- instant feedback about whether their coding was leading to a better game,
- the competitive element of the computer game construction, testing, and peer evaluation,
- provision of choice in the variety or style of game produced, and the way in which they could work alone or with others to develop their product,
- empowerment to produce a game for which they had total responsibility, and
- a classroom format that provided structure while at the same time giving boys some flexibility in the way in which they approached each task.

The test of the hypothesis – how does the use of Gamemaker software foster the development of creative problem-solving skills in boys – was to observe boys exhibiting and documenting these attributes in the Gamemaker exercise and then transferring these skills into other areas of the curriculum.

Research Context

Scotch College, Melbourne, Australia, is a non-selective boys' independent school with classes from Prep (5 year olds) to Year 12. The Junior School runs classes from Prep to Year 6 with an attendance of 430 boys. The ethos of the school is best described in its Memorandum and Articles of Association, which state that the College is required to provide for its students:

> An education of humane, scientific and general nature consistent with the teachings of Christianity…(and to) encourage each student to achieve the highest standard of which he is capable in all his activities.

Scotch College has a reputation for academic success, with over 50% of boys in Year 12 represented in the top 10% of Australian students of this age. As stated earlier, the Junior School profiles strongly in the NAPLAN (National Assessment Program for Literacy and Numeracy) Year 3 and Year 5 tests.

The school provides not only a climate that encourages the best academic performance, but also has a strong pastoral care program that provides comprehensive support for boys who have learning difficulties. Being a non-selective school means that there are several such boys in every class: boys who struggle with the basic elements of literacy and numeracy, and who may also have behavioural issues resulting from frustration with these learning difficulties. So, in addition to a number of very capable students, every classroom in the Junior School accommodates boys at the lower end of the academic spectrum as a result of learning and/or behavioural difficulties. I decided to use the 27 boys in my class for the study because, firstly, it contained a range of academic abilities to test out my action research and secondly, it was far more practical to use my class to organise ready access to the Year 5 laptops.

Letters of consent were completed by parents, which incorporated permission to include all data collected in a written report. Anonymity was protected by changing the boys' first names when being referenced in the report.

The Action

This unit of work using the Gamemaker computer software was undertaken with a class of 27 students over the course of a school term (10 weeks), teaching a double lesson (70 minutes) once each six-day cycle. Each boy used a Macbook Pro laptop with the necessary software installed, as did the teacher, who projected his screen onto an electronic whiteboard.

Boys were introduced to basic programming in the initial five lessons with strategies and techniques demonstrated on the electronic whiteboard. The final five lessons involved the boys designing, creating and refining their own games. All research was done during regular class time, although a number of boys chose to undertake independent research and improvement at home.

Data Collection

Csikszentmihalyi (1999) argued that creativity occurs when an individual (a student) interacts with a socio-cultural setting (the classroom and teacher) within the domain (programming with Gamemaker). He went on to state that the outcomes arising from this interaction are judged by members of the field (at a classroom level, this will be the students and their teacher). This human dimension of creativity lends itself to qualitative methodologies of 'measurement'. Indeed, in trying to form quantitative questions, there is a risk that some of the elements of creativity will be missed in the 'numbers'.

Within this composite of individual, social context, and learning domain, several researchers have identified nine climate dimensions for creativity and innovation (Isaksen & Lauer, 2001; Isaksen et.al., 2001). These are:

- Challenge
- Freedom
- Trust/Openness
- Idea Time
- Playfulness/Humour
- Risk-Taking
- Idea Support
- Debate
- Conflict

These nine climate dimensions are more fully explained in Appendix A.

These dimensions are best addressed through qualitative measures such as classroom videos, one-to-one and group interviews, pre- and post-testing, student journals, and a teacher reflective journal. The pre- and post-tests appear in Appendix B: Gamemaker Unit Pre- and Post-Test.

The pre-test sought information that gave a starting point with respect to the boys' understanding of problem solving. The post-test sought to establish any changes in their understanding of, and strategies used in, problem solving. It could be argued that the pre- and post-tests did not directly, by themselves, give much evidence towards the research question – the development of creative problem-solving skills. However, these tests were looking for evidence that the boys were more aware of what was involved in problem solving. The games produced by the boys, their journal entries and interview comments, and teacher journal reflections provided the evidence for creativity, while the test questions revealed an increased awareness of the strategies needed to tackle problems and the way in which those strategies could then be applied elsewhere.

The reliability of the data came from the range of data sources used. The triangulation of the data gathered from formal pre- and post-testing, interviews, questionnaires, classroom observation in other contexts, and videotapes provided a substantial body of evidence to develop and support the hypothesis of this action research. In addition, two colleagues acted as critical friends by providing insights into the research process, particularly in regard to my action research. They also checked over my work to ensure that important areas were addressed properly and provided validation of the work and process undertaken.

Data Analysis

The key to answering the research question was the extent to which the data could be used to support one or more hypotheses. In a study such as this, it was necessary to use multiple sources of data to provide a broad base of evidence for a particular position.

To ensure the validity of the data, specific questions addressing the focus of the action research were included in the pre- and post-testing and in the interview process. The specific questions that elicited the most telling understandings from the boys in the pre- and post-tests were:

- Problem solving includes many different skills. How do you go about problem solving in a computer game?
- If you have ever made your own computer game, did you have to use problem-solving skills? If so, describe the situation.
- Do you think that learning basic programming skills in Gamemaker has helped you in problem solving? If so, how? (post-test only)

In the answers to the pre-test, there was no evidence that the boys could articulate problem-solving strategies in a computer game situation. In fact, none of the boys had even undertaken any form of game programming. However, after the ten units of the course, the post-test comments indicated a more sophisticated approach to problem solving, not just in relation to computer programming, but also to other aspects of the curriculum.

After looking through the video footage, the pre- and post-tests, the teacher journal and the boys' journals, the analysis of results showed a clear link between boys' creativity and the necessary climates for creativity as identified by Isaksen et al (2001). The nine climate dimensions for creativity identified by Isaksen were grouped into three key elements for ease of discussion and analysis. There was some overlap between climates, on occasion:

Social Construct For Learning

This subheading encompassed the climates of trust/openness, playfulness/humour, idea support, debate and conflict. The social construct for learning, as a necessary and beneficial part of the boys' learning and creating, reflected Papert's thoughts that making a video game, whilst being a very challenging task, also "leads you to reflect on yourself and interact with others" (Papert, 1996).

Challenge

Linked with Papert's view of computer programming providing "hard fun" and being a real challenge, the results, in particular the boys' comments, showed a definite link to Vygotsky's zone of proximal development. This will be elaborated in the discussion of results section. The climate of risk taking was included in this element.

Enjoyment

This subheading included the aspect of playfulness/humour and the fact the boys had the autonomy and resources to make decisions about their learning, in other words, freedom.

Another factor that was not obvious in Isaksen's nine dimensions was student *self-organisation* – the ability of a boy to identify a sequence of tasks, which are prioritised, in order to reach a goal. This element will be discussed in light of the boys' journals and teacher observation.

Discussion of Results

"Today me and Stephen made a front cover for our game, but implementing it in our game was very difficult. Joel showed Stephen while I was trying to find out how, when you land on an enemy vertically they die but if you touch them horizontally, you die. Joel was trying to find the same thing but unfortunately when he did find out how, it had over 30 steps involved so we decided not to use it."

(Adam – student journal)

Two boys from one group, Adam and Stephen, in collaboration with another boy, Joel, identified that their task was **challenging** and that they would need to take risks in order to produce a game that works. Their engagement with this task, both in and out of class, illustrated the **enjoyment** they gained from this challenge notwithstanding the fact that the ultimate goal required the individual steps to be **organised** very carefully.

Social Construct For Learning

Vygotsky (1978) and Papert (1996) have both identified the critical nature of a social learning environment. This study reinforced those findings as can be seen in the following quotes:

"You had helpers and you had a choice on what game you would like to produce."

(Campbell – student journal)

Campbell noted that the final decision of the direction of his game relied upon collaboration with others. Soren felt confident enough, without being asked, to assist with the development of another game:

"I improved Peter's game by making new levels and better guys and lots of things. We also made a front page. Sometimes Peter would work on his own game so at the end we would decide which one was better."

(Soren – student journal)

There was also a reciprocal relationship between the social, the challenge and the risk taking. Having observed peers' games (social), boys were then motivated to improve their own games (challenge and risk taking). As Cameron notes in two quotes from his daily journal reflection:

"I enjoyed playing other people's games to see what they were thinking and what their ideas were...

...I think problem solving means working together as a team to solve a problem. Once you solve a problem, there is always another problem."

(Cameron – student journal)

Cameron's reflection also identified that new questions arise as a result of solving existing problems. Cameron was not alone in his enthusiasm for celebrating others' success:

"The game that stood out for me was Adam and Stephen's because all the levels from start to finish were challenging and there was always a special way to complete the level without dying"

(Phillip – student journal)

Challenge

Isaksen (2001) defined risk taking as going out on a limb without fear of being criticised. Michael identified a problem, chose what he thought was an appropriate response, which did not work. Undeterred, he found a different set of programming strategies that did work. And then, with no further input from others, he identified future strategies to help improve his game:

"For some reason my invisible object didn't obey my programming so when the bad guy collided with the invisible object it went right through and off the game but I fixed the problem by inserting a sprite-tree so there was a picture of a tree and that worked.

What I need to do in Gamemaker:

- **turn the background around**
- **make a repetitive pathway for my other cars**
- **make another room."**

(Michael – student journal)

The boys had difficulty identifying the programming problems that they encountered in their written journals. However, the teacher journal noted many times the willingness of the boys to take risks in attempting to solve their problems. To start with, only 4 of the 27 boys actually gave up on their original games because they could not find a solution to their particular programming problems. All of the other boys completed their initial task successfully with help from other boys, online tutorials, teacher assistance and experimenting with alternative programming.

Stephen noted the joy gained from solving a problem because, as Papert would refer to, it was hard:

> **"I liked that my game that we had gravity and I'm really proud because it is hard to make."**
>
> (Stephen – student journal)

Enjoyment

Papert (1996) referred to the excitement that kids found in video games. Isaksen also identified the climate of playfulness/humour in a creative working environment. Below, Stephen captured both Papert and Isaksen in his post-test comment:

> **"I really enjoyed the sensation of making a real working game"**
>
> (Stephen – post test)

The freedom to choose added to the enjoyment of the task, as Joel noted:

> **"I liked especially in the Gamemaker project having the ability to choose what game you want to do, so it didn't limit our ideas".**
>
> (Joel – post-test)

The teacher journal noted that every time the boys undertook their task of creating and refining a game, the classroom buzz was one of excitement that you only hear when boys are totally engaged in their learning and participating in a collaborative learning adventure.

Self-Organisation

At the conclusion of the programming sessions, the boys wrote their reflective journals. One of the questions asked the boys to identify what they needed to do to next in terms of programming. Ultimately, those games that were enjoyed and admired most by the boys, as reflected in a popular vote, were those games that they identified in their comments as the most challenging. More than half of the responses specifically referred to the challenge of the game being the determining factor in their choice of favourite game.

The most popular games were produced by boys whose programs and reflections best demonstrated that they had thought through the structure and sequence of their game. Here are the words of the boys who overlaid the organisational dimension to enhance the creative dimension of their games:

> **"Today we didn't make that many changes into our game directly, but we did set things up for next session."**
>
> (Adam – student journal)

Joel provided an elegant summary of his group's organisation approach:

> **"What we need to achieve:**
> - **? New level**
> - **? End screen**
> - **Check all properties and commands**
> - **Get Year Six to play game and ask for feedback**
> - **Check error messages**
> - **(If heaps of time left and is easy, make scoreboard)"**
>
> (Joel – student journal)

Joel used the question mark to identify items that would require further assistance to solve. For an eleven year old, this was a fairly sophisticated analysis of the organisational imperatives of a problem-solving task.

However, not all of the challenges could be completed successfully. As Phillip noted in an interview:

> **"We still hadn't solved the glitch problem so we tried making our good guys and bad guys smaller but that didn't work either. So, we looked up a tutorial on how to fix it and surprisingly that didn't work so we gave up.**
>
> **Today, I learnt how to make different sounds when you press any key thanks to Stephen."**
>
> (Phillip – student interview)

Despite this apparent failure, the boys in the group still demonstrated the social element, the challenge, the enjoyment and moreover, despite their perceived failure, they chose to solve a different problem with the help of peers.

Transferability

One of the questions in the post-test asked the boys:

> **"Do you think that learning basic programming skills in Gamemaker has helped you in problem solving? If so, how?"**

Out of these four elements addressed previously, the boys identified that what had emerged from this activity had relevance elsewhere in their learning. Indeed, there was evidence from the boys themselves that the skills that they had picked up from this activity transferred to other elements of their school life:

> **"Yes it has. It has taught me new ways to solve problems in and out of Gamemaker. I've actually used it in a Maths problem."**
>
> (Joel – post-test)

"Solving problems on Gamemaker helped me a lot in Maths because usually I rush through my work but problem solving on Gamemaker helped me slow down."

(Phillip – post-test)

"Yes definitely it has made me more self reliant in problem solving and to think about problems more."

(Adam – post-test)

"Yes it has showed me that there are lots of different ways to solve one problem."

(Stephen – post-test)

"Yes because I have realised how important trial and error is."

(Douglas – post-test)

Conclusion

The creation of new ideas requires that we couple thinking strategies that are critical, systematic, and analytical with those that are creative, intuitive, divergent and lateral (Lavonen, Meisalo and Lattu, 2001). The work of Lavonen et al. embraced Cattell's (1967, summarised by Cherry, 2012) concepts of fluid and crystallized intelligence.

Fluid intelligence is defined as "the ability to perceive relationships independent of previous practice or instruction concerning those relationships". It involves being able to think or reason under novel conditions, conditions such as those that exist when the boys construct the solution to a problem in Gamemaker. Crystallised intelligence involves knowledge that comes from prior learning and past experiences. In partnership, these two dimensions of intelligence provide the tools for dealing with the spectrum of learning tasks that we undertake. (Lavonen, J.M., Meisalo, V.P., & Lattu, M., 2001)

The present study supports this contention that creative ideas, in the form of computer games, arise from a combination of innovative and imaginative approaches, collaborative exploration of ill-defined, complex and meaningful problems, together with a systematic and logical approach to a final outcome.

In the Gamemaker unit, the boys with the most creative games were the most organised. Creativity and logic needed to be combined for these boys to produce the most popular, challenging and innovative games. The starting point for the programming exercise was for the boys to think up ideas for a game. For the ideas to become useful, the boys needed to think of a list of what was required to bring the ideas to a desired outcome, do their own study to improve their learning and evaluate their work on their own. This formed a feedback loop, the same loop that underpins action research. Even in this immersion in creativity, the systems approach/action research approach was integral to the process, but it is important to note that it arose out of creativity – out of the ideas of the boys.

They discovered, without teacher direction, systems theory with learning loops that helped remodel and reshape their ideas into valuable outcomes.

The boys recognised that if they were not logical, the process did not work as well. Without this combination of imagination and logic, all they ended up with was an incomplete game with major programming flaws. By using a feedback loop, boys played around with their programming and often found solutions by themselves, which they could then share with others. In particular, the use of online help sites proved to be beneficial. Boys looked at the advice and remodelled their programming to include the necessary steps.

Looking at the experiences of the boys through their journaling, it appears that the Gamemaker activity brought the two different styles of intelligence together, perhaps in a form more powerful than many other learning activities. It allowed for learning from the teacher of how to undertake basic programming. The boys were then encouraged to learn from other sources about how to solve programming issues. However, the activity was open ended enough for boys to look back at their own games and evaluate their overall merit, perhaps after comparing them to a peer's work. By being able to bring their own ideas and those of others to what they already know, the process enabled problem-solving strategies to develop in boys, as well as embedding the creativity side to such thinking.

Attitudinal, cognitive and experiential factors are important elements of problem solving (Lavonen et al. op. cit.). In the Gamemaker activity, boys undertook tasks that they found engaging, motivating, and interesting; tasks that required them to push the boundaries of their current cognitive experiences, yet in a mutually supportive and non-judgmental environment. Arguably, the learning context for the boys in this study was authentic in that the tasks were ill-defined, complex, had multiple solutions, required self-direction and the identification of the resources necessary to complete the task, but were often made much easier through collaboration.

Providing the initial instruction in the use of the programming language in Gamemaker was important to streamline the development of the creative elements of the final games. It is interesting to speculate on what the boys might have achieved without this more formal introduction. The question of whether this formal introduction to gaming protocols produced the series of similar game styles observed in this study is not answered here. Typically slower learners may have experienced significant difficulties if they had been required to learn the programming language for themselves in addition to creating a viable final game.

While the teacher took on the role of tutor for boys experiencing difficulties, for the most part the boys resolved issues by working with other boys and with online tutorials accessed outside of class. The boys were sufficiently engaged with the task to spend significant periods of their own time searching for strategies that could be implemented in their programs.

One interesting finding emerging from this study was the extent to which students can adapt to a different learning environment.

Those boys who have struggled with more conventional classroom tasks were able to complete this project without having to risk being highlighted as 'slow learners' or boys who have difficulty persisting with a hard task. Indeed, four of the boys who struggled with other aspects of their learning were able to produce games that were highly regarded by others. Off-task behaviour that had been apparent in some other learning situations was never an issue when the class was immersed in Gamemaker activities.

This study began with the question, "How does the use of Gamemaker software foster the development of creative problem-solving skills in boys?". The evidence here and in various reflective journals and video records supports the hypothesis that when boys construct their own computer games in a classroom that encourages risk taking, cooperative endeavour, competition and challenge, they do create new products. These products represent tangible evidence not only of boys' creativity, but also of boys constructing meaning from the interaction with the gaming software and with other boys. Without the gaming software, these elements of creativity and constructing meaning would not emerge.

Implications for Future Practice

Did the attributes and skills that the boys gained through this activity emerge anywhere else in their learning? The issue of transferability is one that can be difficult to see. It may be a tenuous link, but what I saw from some of the boys in their improved approach to problem solving, particularly in Mathematics later in the year, may well have been due to their experiences solving problems in Gamemaker. As mentioned in the previous section, many of the boys could identify and articulate how the Gamemaker experience improved their ability to solve problems in other areas of the curriculum. The recommendation I take from these comments is that I need to undertake the Gamemaker unit of work earlier in the year so that I can look for transferability over a greater period of time.

Contemporary software packages such a Minecraft offer similar (and perhaps more popular and 'relevant') options for good learning to that of Gamemaker. Minecraft includes child-initiated projects, engagement, challenging and open-ended tasks, multiple solutions, and significant opportunities for collaboration both within a specific game and in an online (multiplayer/developer) environment. Minecraft lends itself to a range of abilities as it requires no sophisticated programming knowledge but nevertheless requires higher order creative and critical thinking to produce scenarios of the highest calibre. As such, this is a possible area for further action research. Indeed, it could be worthwhile to compare the relative strengths of Gamemaker and Minecraft in terms of the benefits for boys in terms of fostering creative problem solving.

Reflection Statement

The major benefit for a teacher undertaking action research is that it forces you to critically analyse your own work for effectiveness, student engagement and the outcomes you wish to achieve. In addition, it allows for the discussion of unexpected outcomes – both positive and negative. The challenge for the future is to use the systems approach feedback loop essential to action research to further refine the Gamemaker unit of work. Perhaps the most rewarding section was almost the hardest, reflecting on the work of Vygotsky, Papert and on other research relating to the development of creativity. Trying to get the boys to reflect on their work in written form was initially a particularly tough task. Many of the boys didn't identify any problems that they encountered – even after I pointed them out! However, by modelling and sharing good examples, the boys became proficient at self reflection on their work. Hopefully, the boys will be able to transfer this skill to other areas of the curriculum.

Having undertaken this action research, I feel justified in pushing for this Gamemaker unit of study to be permanently included in the Year Five curriculum. The hurdle is trying to find enough time to teach the unit properly, whilst not neglecting other core subjects.

I was very fortunate to have a particularly helpful critical friend in Dr Peter Lewis. He was never too critical and often suggested previous research to read, which always proved beneficial. In addition, his help in discussing how the project should progress made me think very deeply on what it was I actually wanting the boys to achieve. I was also lucky to have another critical friend in Dr Peter Coutis, who helped me organise my research and findings in a far more logical structure. And finally, thank you to my supervisor Margot Long, whose advice was both constructive and sage. She could not have been more thoughtful in her counsel.

Appendix A

Explanation of terms or Isaksen and Lauer's Nine Climate Dimensions for Creativity and Innovation

Several researchers have identified nine climate dimensions for creativity and innovation (Isaksen & Lauer, 2001; Isaksen et.al., 2001). These are:

- Challenge - the task is engaging and meaningful.
- Freedom - boys have autonomy and resources to make decisions about their learning.
- Trust/Openness - boys are open and frank with other boys and the teacher. There is mutual respect and support.
- Idea Time - boys have time to generate, explore, and develop programming ideas and produce quality products.
- Playfulness/Humour - the classroom is purposeful, easy-going, and is a fun place to be.
- Risk-Taking - boys can go out on a limb without fear of being criticised.
- Idea Support - innovative and/or different solutions are encouraged. Suggestions are not dismissed without due consideration and consultation.
- Debate - boys put different and perhaps competing ideas. These are constructively discussed.
- Conflict - boys and the teacher accept and deal with diversity. Power struggles are minimised and the emotional tension is low.

Appendix B

Gamemaker Unit Pre- and Post-Test

Computer Games and Problem Solving

Name: ______________________________

1. Name two or three of your favourite computer games
2. What do you like about each of these games?
3. What makes you want to play these games again and again?
4. Problem solving includes many different skills. How do you go about problem solving in a computer game?
5. If you have ever made your own computer game, did you have to use problem solving skills? If so, describe the situation.

Computer Games and Problem Solving

1. *(Only as Post-Test)*
   Do you think that learning basic programming skills in Gamemaker has helped you in problem solving? If so, how?
2. *(Only as Post-Test)*
   What did you enjoy about the Gamemaker rotations?
3. *(Only as Post-Test)*
   How could the Gamemaker rotations be improved?

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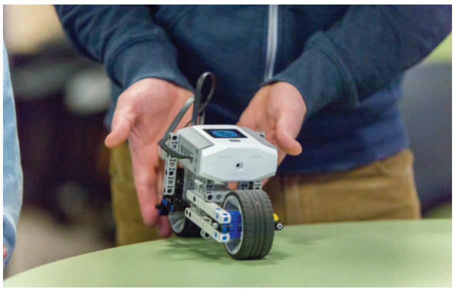
Centre Com is a commercial sponsor and partner of Digital Learning and Teaching Victoria.
Centre Com's Greg Bowen writes about Centre Com's philosophy as a reseller and educational partner.

Building a platform for change and redesigning the role of a reseller



After a lifetime of teaching and now visiting schools there are a couple of things that push my buttons.

Listening to the radio, I often hear presentations from incredibly committed people discussing their concerns about a community problem.

I do not want to denigrate the importance of the issues or the critical need for our society to address them in any way, however, the general conclusion is that we must have schools address the problem.

It's the captive audience approach: We have a problem, we must get young people aware of this, where can we find a lot of young people? Answer: At schools, and even better, there are very skilled people who can get the information across correctly.

My issue is that there is rarely any attempt to provide the levels of resources, support or funding that are required. These are just added to all the other social, educational and welfare issues placed on teachers. Generally and to their credit, schools and teachers have risen to these challenges and implemented many exceptional programs to improve society.

The truth is that if we want to move forward, all sectors of the community including our politicians, media, educators, students, industry and the corporate sector must get behind schools and identify how they will support the desired change.

As part of the Education team for a major ICT reseller we have looked at this challenge and implemented an educational program to provide the resources and support for change. We believe that our Australian economy will need to have highly skilled, globally connected and innovative ICT leaders to create the new technologies and solutions for our future global challenges. These leaders, our students of today, will need diverse skills across all areas of the curriculum as well as the competencies required to succeed.

Schools also need the resources and support to develop programs to build these skills across the curriculum. To achieve this, we have embarked on four key strategies:

Dedicated staff

We have employed a fully qualified and experienced STEM/Robotics teacher to support schools through the change process with curriculum, training and advice for your staff and school leaders.

Abilix Educational robotics products.

We have partnered with the manufacturers of Abilix educational robots and have carefully selected three main product ranges for Australian schools. These products are modular, programmable across multiple platforms and coding environments, and affordably priced to cater for whole-class use.

Curriculum resources matched to the STEM and DigiTech curriculums.

We have built a Learning Management System with resources and activities enabling students to work at their own pace.

Teachers can monitor progress and provide ongoing feedback. They can also contribute to the growth and development of these curriculum resources as new lessons are written.

These resources are designed with a Problem-Based Learning approach, utilizing real-life scenarios and incorporating all elements of the engineering design process.

World Educational Robot (WER) Contest

This is a global, well-established robotics competition with over 100,000 participants in more than 50 countries worldwide.

Our Australian International event for Primary and Secondary teams of two or three students will be part of National Science Week activities in Melbourne in August.

Our company wants to redesign the relationship between schools and resellers to be a joint process of supporting our new leaders of the future to succeed.

We can help schools achieve their goals and are keen to use our resources in this endeavour.

Please contact us to discuss how we can help or how you can access any of the resources or events listed above.

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USING ROBOTS AND DIGITECH FOR STUDENTS WITH DISABILITIES

K. Clark Burt

Abstract

The Digital Technologies Curriculum in the Australian Curriculum is meant to prepare young adults for living and working in this new century. With the ever-changing possibilities of the latest technological innovations, this curriculum was designed to promote digital thinking and to prepare Australian students for what technological advances might exist when they get into the workplace.

However, this new curriculum highlights a growing problem: will students with disabilities be able to learn these abstract concepts? And how should teachers be preparing these students for a digital world? The Design and Technologies strand of the Technologies curriculum is too abstract for a school-aged child with an intellectual disability. The other strand, Digital Technologies, is what educators should be focusing on in their classrooms.

Digital Technologies include basic computational thinking, manipulation of objects, and interaction with digital devices such as robots and the newly introduced digital pet, Cozmo, a robot with an artificial intelligence that creates meaningful play. These new robots can help teach a range of skills from coding to emotional regulation. Educators should consider incorporating more artificial intelligent robots into their classrooms.

Keywords

Digital Technologies, Intellectual Disabilities, Special Education, Robots, Artificial Intelligence

Conflict of Interest

Please note that I do not work for, nor have received any incentive for including a discussion of the Cozmo robot by Anki in this paper. The views about this product are my own opinions based on my experiences using the robot in special education classrooms.

Technologies Curriculum

With the rapid change in technology at the turn of the 21st century, many educators advocated for a definition of '21st century skills', the training and knowledge that young people needed to work and live around these new technologies. Marc Prensky (2001) believes that this next generation thinks differently, and they expect to interact, construct, and discover as they learn. With the new Australian Curriculum, there is now a clear developmental construct for teaching all ages of students how to think in this new digital century.

The Technologies learning area consists of two subjects: Design and Technologies and Digital Technologies (Australian Curriculum, Assessment and Reporting Authority [ACARA], n.d.). The ICT teaching and learning in previous curriculums are now removed from Technologies and are classified as a general capability called Information and Communication Technology (ICT) capability spanning across all learning areas.

Design and Technologies emphasizes design thinking where students consider the societal and environmental implications of technological problems and solutions (ACARA, n.d.). In other words, this is teaching a global, holistic approach to solving complex issues. Digital Technologies includes general ICT knowledge, project management, computational thinking, and data management. Here, students use various technologies to create digital solutions.

This new emphasis on thinking is certainly important for the next generation workforce. However, this new curriculum highlights a growing problem: how will students with intellectual and cognitive disabilities participate in this new curriculum? The Design and Technologies subject is arguably too abstract for students below or at Foundation level.

In Australia, a person may be given a diagnosis of intellectual disability (ID) if they have a sub-average intelligence (typically defined as an Intelligence Quotient [IQ] below 70), limitations in communication and self-care, and a lack of daily living skills

(Westwood, 2002). 2.9% of the Australian population has an intellectual disability, "with prevalence rates of 4% for children aged 0-14 years" (Australian Bureau of Statistics, 2014, para. 2). Children with an intellectual disability are cognitively delayed in their development and need additional support throughout their lives.

Jean Piaget believed that a child develops through four distinct stages of mental development from birth into adulthood (Inhelder, 1966). While his research methodology was flawed, he argues that a child will have difficulty with abstract, intuitive, and systematic thinking until their brain matures (at around 11 years of age for a typically developing child). Similarly, Leo Vygotstky (1978) believed that abstract thinking is initially not available until a child can conceptualize symbols. Children with an intellectual disability are likely to have difficulty conceptualizing abstract concepts during their school years, particularly those with Autism Spectrum Disorder (Preissler, 2006; Westwood, 2002). Therefore, it is more than likely that the cognitive demands of Design and Technologies unfortunately make this new subject not 'available' to students who have an intellectual impairment.

Which is why I argue that the Design and Technologies subject is not appropriate for students who are pre-Foundational, and educators should instead be focused on the other subject, Digital Technologies, in their lesson planning.

Implementing and differentiating the curriculum

The new Digital Technologies curriculum in the Australian Curriculum expects teachers to incorporate more coding, problem-solving, and deep-level thinking tasks in their lessons. This initially seems like a difficult task, but there are many ways teachers can link their current lessons to the new curriculum. For example, reading/sorting/making a visual schedule is just one example of coding and sequencing that meets the new curriculum standards.

While the Australian Curriculum divides the Digital Technologies subject into two strands, Knowing & Understanding and Processes & Production Skills, I recommend that teachers approach the learning area and teach it in three separate sections. The first section is, in many ways, the old ICT curriculum in that it is the explicit teaching of hardware, software, and networking of ICT. Second, teachers should focus on collecting, sorting and sequencing, and using data. There are many forms of data including pictures, symbols, codes, and, of course letters, words and numbers. These activities are likely already part of teachers' lesson plans, but until now were never thought of as computational thinking.

Third and finally, teachers should look at using ICT for problem solving by teaching students to use a framework to analyze problems, test designs, and evaluate solutions. Despite how it is divided, Digital Technologies is simply a new way of looking at how we teach children to interact with technology and how to think about symbols, patterns, and sequences.

Modifying for those with disabilities

As mentioned above, teachers can modify tasks they are already doing to meet the requirements of this new curriculum. Despite the ICT-focus, teachers can use non-ICT activities to teach the concepts and get students thinking in sequential, logical, and computational ways. For example, an algorithm is simply a series of steps. A visual calendar of the day's schedule is an algorithm and students can even create their own schedules by taking photos (collecting data), sorting them (sequencing), and displaying them on a chart.

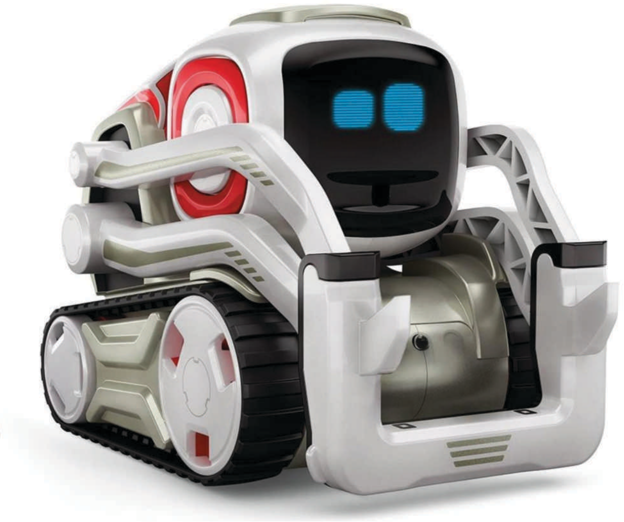
Thus, while the wording of the curriculum is rather technical and possibly confronting to a teacher of low ability students, I encourage teachers to think about what they already do in their classrooms as evidence of meeting the goals of this curriculum. Teachers, do not spent too much time on the complexities of today's technology because the next big thing for special education is just about here.

Robots & Digital Pets

Robotics have been used in education for the past few years, but with the advances in artificial intelligence, the next area of focus should be on digital pets. A digital pet is a robot with a programmed 'personality' that interacts with a user's speech and movements. In other words, robots now are becoming playmates who can talk, play games with, and who shows emotions like happiness, sadness, and anger.

While coding and project management are important skills, what is missing from the Digital Technologies curriculum is the use of robots for play and social emotional learning. And for students with disabilities, this digital interaction is a perfect tool for teaching social emotional skills. Slowly there have been an increase in interactive toys such as Beebots, Spheros, and Lego Mindstorms, which do build skills in coding, spatial awareness, and planning. But it is the inclusion of a 'personality' with emotions, even if computer generated like the new robot, Cozmo by Anki, could be as big of a revolution to the special education classroom as the iPad was.

Cozmo is a personal companion robot designed not just for coding and controlling but designed as a digital pet—a responsive plaything with built in games (Anki, 2018).



Cozmo is eight centimeters tall and nine centimeters long. He looks like a cross between Wall-E and EVE from Pixar. He might be digital, but he is a member of the newest innovation: digital pets. And he can be used to teach social skills, responsibility, and literacy.

Cozmo, is controlled by an iPad/iPhone app. Cozmo has his own personality and he talks and sings. Every day you are expected to wake Cozmo up, 'feed' him, play games with him, and perform maintenance tasks to keep him 'fit' These tasks are not only engaging but also rewarding. Eichenbaum, Bavelier, and Green (2014) suggest that this interaction in which a user receives rewards can lead to an increase of dopamine in the brain, which may permit brain plasticity and learning.

The games can feature one or two students playing with Cozmo at a time, perfect for learning turn-taking and socialization skills. Cozmo also sings, plays 'peek-a-boo', and recognises faces. For students with autism, for example, where social play creates anxiety, Cozmo could be a new learning tool, and special educators need to start trialing AI robots in their classes. Further, besides social emotional goals, Cozmo is also capable of helping students meet the other curriculum goals in the Technologies learning area, such as programming, sequencing, and collecting data.

In my personal experience of introducing students with disabilities to Cozmo, there has been overwhelming excitement and engagement with him and his features. I have informally trialed several of Cozmo's games on students with mild intellectual disabilities and, while I did not try to assess any curriculum goals during gameplay, students were very engaged and receptive Cozmo's 'personality'. Overall, my initial attempts at using Cozmo in the classroom were all positive (despite some young boys wanting to play with him roughly). With the continuous improvements not only in this product, but in AI overall, this is certainly a learning tool that needs to be investigated and researched.

Conclusion

Some of the best ideas, evidence and research comes from teachers themselves. Research is what is now needed for digital pets in the special education classroom and I urge teachers investigate robots to not only to meet the needs of the Technologies curriculum, but to meet social emotional needs as well. I hope my trials with Cozmo encourage you to try your favourite digital pet in the classroom. We have a very interesting future ahead of us where artificial intelligence and robotics can support our students.

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DITCHING THE DESKS

FLEXIBLE LEARNING SPACES FOCUS ON HELPING STUDENTS BE PRODUCTIVE, COMFORTABLE

By Tim Douglas

Believe it or not, Jeff Spicoli may have been onto something.

"I've been thinking about this, Mr. Hand. If I'm here and you're here, doesn't that make it our time? Certainly, there's nothing wrong with a little feast on our time."

Spicoli may have been a fictional character who delivered this classic line in the 1980s movie "Fast Times at Ridgemont High" to explain his view of classroom dynamics to his teacher, Mr. Hand, but it makes a great deal of sense today: Instruction time belongs to both teacher and student.

But what about the environment? How has the use of classroom space changed since the '80s, or, or for that matter, over the past 100 years?

SPACE TIME OVER FACE TIME

The most effective and efficient boardrooms, offices, factories and fields allow a certain freedom in getting the work done. We are better in groups, particularly when we have a choice in how and where we handle the job. This certainly applies to classrooms as well. Instead of teachers delivering the daily lessons to rows of students, what if instructors trusted their students to choose their places? Instead of demanding to see faces, what if teachers stressed spaces?

Flexible learning spaces and classrooms that create active learning environments are gaining in popularity. Around the world, educators are moving away from seating charts and toward overstuffed chairs and alternative furnishings. Many are also saying goodbye to the teacher's desk. In fact, the movement has its own hashtag: #ditchthedesk.

To ditch the desk, however, requires understanding all that comes with this classroom transformation.

"Classrooms are time stuck," says Kayla Delzer, a third grade teacher at Mapleton Elementary in Mapleton, North Dakota, and a recognized pioneer in the flexible learning space movement. "I showed two pictures [to a colleague] of two classrooms. One was shot in the 1950s. The other was taken just recently. The only difference? One was in black and white. Our education system has been OK, but we can do better. The world is full of change, yet classrooms aren't."

THE COMFORT ZONE

There is much to be said about being relaxed and content. There are comfort foods, comfort clothes and creature comforts. We're more likely to be more productive when we're comfortable – and that applies to adults and students.

Words of wisdom from Meredith Douglas, a sixth grader, at Garfield Elementary School in Clovis, California. "Why should we just sit there? It feels better to move around. We're students, not statues."

Comfort is but one component. Shifting to a flexible space requires thought, intention and meeting the ultimate goal: helping students achieve and learn at the highest level. To begin, teachers need to be mentally ready. It's important to understand the "why" when making this shift.

"People get too wrapped up in the furniture piece," says Ilsa Dohmen, a sixth grade science teacher at Hillbrook School in Los Gatos, California. "This is about shifting a mindset and teachers giving more control to students. As adults, we have a sense of how we work best, yet we govern kids."

Giving up the governance takes faith, but a key mechanism for improving schools nationwide and globally can be described in a single word: relationships, which require trust. Going from a controlled environment that is run by one person to one that may appear at times to border on bedlam takes buy-in from beyond the classroom.

It's not only the teacher and the students who need to trust each other. Administration, district leaders, parents and families all need to be on board, and teachers need to remember they're not giving up everything.

In an email, Chris Johnson, interim director and assistant professor with the Educational Technology Program at the University of Arizona South, and ISTE member, says that individual educators can begin by realizing they do have control of the components of their classroom, such as the instructional activities. However, teachers can't assume they will do this in a vacuum. "I would make sure I had talked to my principal … to discuss how this will change my instruction and improve student learning. I'd do this after researching the impact of space on learning and have a general idea of what I wanted to do," Johnson writes.

KEEP IT SIMPLE

Dale Basye, a content developer at Clarity Innovations, a company that "matches promising technologies to the needs of education," says to keep it simple when creating a flexible learning environment.

"When you think about it, all classrooms start empty," he explains via email. "So educators can begin by thinking about an empty classroom space: imagining it without furniture, with blank white walls, no lighting, etc. Then start thinking about how that space could better support learning."

Schools and teachers can also proceed at their own pace. There's no need to attempt to make every change at once. A simple pilot program is one way to start, where rows become circles for a day. Flexibility can take many forms. A teacher might allow a student to go outside without asking permission or to get a drink or to stand up. The only limits are the imagination and being mindful of all the resources.

"Another key step in designing an effective classroom is gathering information from students: the most important users of the learning space," Basye notes. "Ask them what makes them feel comfortable and productive."

INVITE PEOPLE IN

As teachers proceed, it's a good idea to share in order to maintain trust among all the stakeholders.

"The easiest way to make [flexible learning environments] the norm is to invite people – everyone – into the classroom," says Bill Selak, director of technology at Hillbrook. "At our school, we say, 'hey, come in and see for yourself.' And this is where technology is so important. We send pictures of students engaged and learning through Instagram or Snapchat, and it's painfully obvious how effective it is."

"I want to make this process, this new environment, as transparent as I can," Delzer says. "I post every day. Technology allows us to have an incredible open door policy, and we need to take advantage."

Sharing also enhances professional development and encourages collaboration.

"Reaching out and including others works very well," writes Johnson,who also chairs the ISTE Learning Space Professional Learning Network. "The PLN is a great place to post a question like, 'hey, I'm thinking of doing this ... has anyone else tried it?'"

A MATTER OF MATERIALS

Once a teacher has adopted the mindset, there is a matter of materials. Again, creating flexible learning spaces and classrooms that allow for active learning is not about the furniture, but teachers do need some tools.

The shopping list needs to be practical, not pricey. Teachers and schools need to keep in mind the end goal is to educate students effectively, and, preferably, economically. Without tremendous thought and foresight, an expensive piece of furniture is just that, and doesn't move the needle for a teacher's classroom or the student.

"Raising a table is free or taking the legs off a table is free," Delzer says. "I strongly endorse standing – my students have a lot of energy – and to provide comfortable standing space is free."

Dohmen, who is also the director of professional development and the director of the Center for Teaching Excellence at Hillbrook, and her students are advocates of the TenJam: large, cylindrical, high-density, foam shapesthat her students use in a variety of ways.

"They will put it on a table and sit on it, or on top of a chair and sit on it," she said. "The biggest thing is giving kids a choice, and that goes back to trust. [Trust] is free if you allow it."

At Hillbrook, there are some staples – the whiteboards on wheels that are actually tables and "wiggle" stools that let children fidget easily – but the emphasis is on creating the room together.

"It's not a one-size-fits-all approach, and more importantly, we don't have names attached to our classrooms," Selak says. "Multiple adults have access to each space. It's a feeling of 'our space,' not 'my space,' with our students."

Chairs that *encourage* students to fidget. Couches. Children lying on the floor. Surely this isn't comfort. It's chaos, right?

Selak, who works closely with Dohmen, tells the story of one student who was videotaped "on the green squishy thing (the TenJam), and if you just saw the tape without the audio, you would think this kid was out of control. He's really moving and squirming, but he's actually hyper focused and really involved. His engagement was off the charts."

GO FOR ENGAGEMENT

On the other hand, students shouldn't abuse the comfortable environment. It's a new classroom contract being created on the fly.

"I don't know if there's an answer or a formula to make sure a class doesn't go off the rails," Selak says. "But what if this is what engagement really looks like? It's noisy, but it works."

"Letting go of some control is key to giving students more ownership of their learning," Basye writes. "There is this fear that students will go crazy if the teacher can't see them at all times … active learning spaces require students to make ongoing decisions about which particular spaces match their individual needs. With the right amount of support and practice in how to monitor student performance, students will begin to develop their own self-management skills, which is a vital life skill."

In many ways, this is how the real world works. It's messy, far from perfect and demands pragmatism. The new classroom is a testing ground for what's in store for students, but teachers still have the ultimate oversight.

"Flexible doesn't mean lack of structure," Delzer says. "Work isn't a choice, but where you do it is."

Allowing students to design their own flexible learning environment offers the added benefit of addressing the Innovative Designer standard within the 2016 ISTE Standards for Students. That standard expects students to "use a variety of technologies within a design process to identify and solve problems by creating new, useful or imaginative solutions."

But do flexible spaces actually improve learning? Those who've created learning environments say "yes."

Delzer compared the math test results of her students in an environment they created together vs. those of students in a traditional classroom. Delzer's students scored 15 percent higher than the other group.

Nearly four years ago, Hillbrook implemented this practice in one classroom. It was so well received, the entire campus is now flexible. While there is data that supports the complete switch at Hillbrook, the move was really based on personal feedback.

"We wanted to be really intentional about changing the space throughout," Dohmen said. "So we conducted interviews with teachers and students, and in interview after interview, we heard how this was freedom and that it felt more real. It was then clear to us what we needed to do."

What works for Hillbrook or anywhere else may not be a good fit for another school, but space exploration in the classroom may be here to stay as trendsetters push for evolution in education. Teachers and students share time and space – this isn't likely to change much in the coming years – which means education is really about relationships.

"There is online learning and online classes and some who think classrooms are going away," Dohmen says. "But I think we will have schools for quite some time. Learning is fundamentally social. I think we all know that, and anything that improves our ability to be social in the classroom, that will stick. Flexible spaces are here to stay."

3 powerful words can unlock computer science success

By Janice Mak

This article originally appeared as a blog post. To access the online version and related links visit www.bit.ly/2PzajwF

I was reminded recently of the three powerful words that capture the everyday miracles of learning and teaching. It happened as my sixth graders were just beginning to create ordered and unordered lists during their first lessons in HTML. All at once, I heard a chorus of voices exclaim with joy, "I did it!"

There you have it. Three powerful words. I did it.

It struck me in that moment that this is what learning is all about. It's about being able to do something that I was not previously able to do. It''s about surprising myself with what I am capable of doing. It's about stretching beyond what is currently possible and continuing to push the boundaries of what is possible. That is empowerment.

The most incredible thing is that pretty soon these "I did it's" will imperceptibly lead to a shift in mindset to "I can do it." And, as a computer science educator, this shift is precisely what is most needed to expand participation in computing. This shift will allow students who previously could not envision themselves as computer scientists to do computer science in creative and innovative ways to solve problems in personally relevant ways.

But as I reflect on these inspiring moments, I have to wonder if I have students who still cannot say those three words. I think of Abby, one of three eighth grade girls in my class of 37 students who on the second day of school approached me in tears saying she didn't think she could be successful in computer science because "everyone already knew" more than she did (or so she thought).

At that moment, I realized that there are barriers to computer science hidden from sight — barriers that are in the minds, hearts and perceptions of my students. I also realized a tremendous commission — to teach in a way that could overcome these barriers.

Asking myself these questions brings to mind reading I've done on universal design (UD) and the parallels between UD in the physical world with architecture and Universal Design for Learning.

I love that in the 10 things to know about UD the first thing to know is "Universal Design strives to improve the original design concept by making it more inclusive." In teaching, the same applies. As I strive to provide these "I did it" experiences to all of my students, it's about making my lesson more inclusive without taking away any rigor. It's also about understanding that UD "aspires to benefit every member of the population by promoting accessible and usable products, services and environments."

In the classroom it's about using strategies and approaches that benefit all of my students, leading to an inclusive learning environment where every student has access to these "I did it" experiences.

Here are some ways you can do it in your classroom or school:

Build pair programming into your computer science classes.

Pair programming is an approach where two programmers work together at one workstation. One, the driver, writes code while the other, the navigator, has the big picture in mind and coaches the driver as the code is being entered. I have my students switch roles of "driver" and "navigator" every 5-10 minutes, which allows them to collaborate, communicate and problem-solve together.

The National Center for Women and Information Technology (NCWIT) has resources to support the integration of this collaborative learning structure. This student-friendly video models, demonstrates and defines pair programming.

Give students opportunities to see computer scientists at work in the real world.

This video from Code.org shows how computer science is changing everything. Careers with Code and its magazine contain a diverse representation of computer scientists along with ideas and actions that students can take to propel their careers forward.

The Girls in IT: The Facts Infographic from NCWIT provides a strong case for why we need to ensure broad representation in computing, the deterrents that exist and what we can do to overcome barriers to diversity.

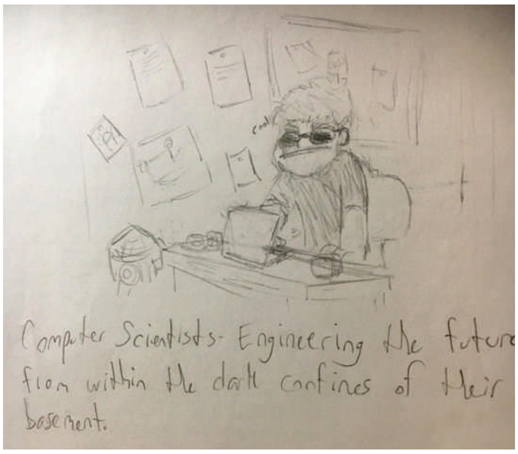
Technolochicas aims to inspire and raise awareness among Latinas and their families about the opportunities that exist in technology. Mission Possible, Life in Code, and What's your Coding Super Power? from NCWIT are three downloadable posters that ignites students' thinking about all the possibilities and applications that come with the field of computer science, inspiring them to make a difference in the world around them.

Reaching out to various women in computing groups at local universities and industry and inviting them to my classroom as guest speakers has been an incredible way to bring their stories to life.

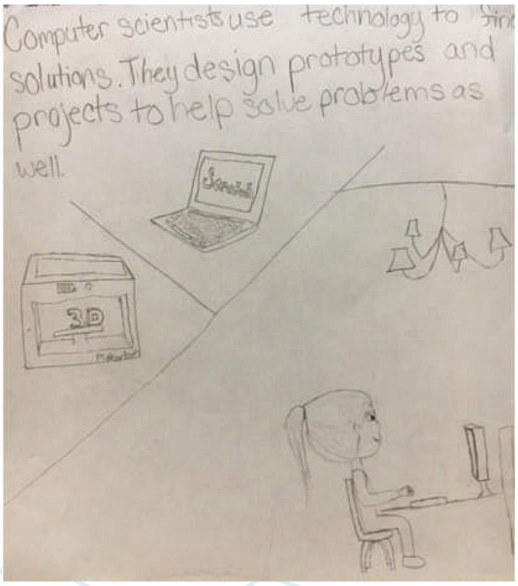
We held a districtwide event to highlight the personal journeys of women in IT through the lens of their passion, inspiration, perseverance and advocacy. I really want my students to view themselves as computer scientists who can impact the world through their creative solutions.

That's why I like to have my students draw what they picture a computer scientist looks like at the beginning and the end of a semester. Here is what I love to see:

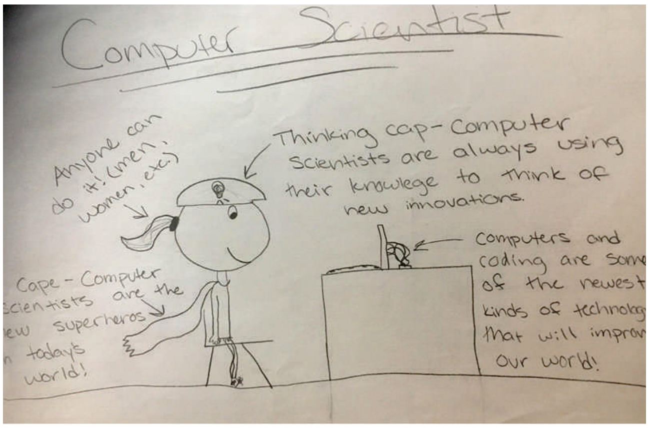
Students shifting their perception of computer scientists from this image:



To this image:



Or to this one, where computer scientists are today's superheroes and anyone can do it!



Allow students to solve authentic problems.

I really like the concept behind Technovation and the Verizon App Challenge, which provides students with opportunities to identify a problem in their community, research existing apps that address a similar problem and design an innovative app to solve this problem. The cross-curricular connections abound in this project as well as the opportunities for my students to communicate, collaborate and solve problems in teams, thereby creating the "artists" who are only limited by the power of their imaginations.

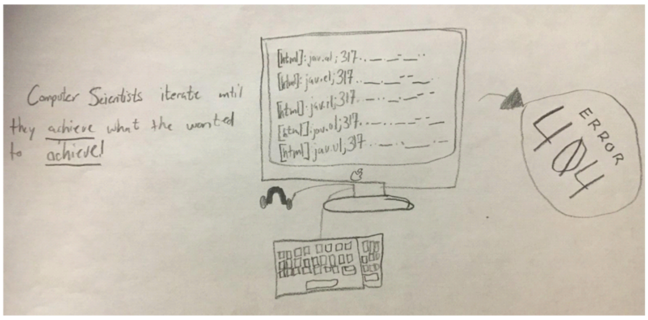
These types of projects address the ISTE Standards for Educators, which call on teachers to "challenge students to use a design process and computational thinking to innovate and solve problems." And they allow students to address the ISTE Standards for Students by "using a variety of technologies within a design process to identify and solve problems by creating new, useful or imaginative solutions."

Explicitly teach and model perseverance along with a growth mindset.

With computer science, the opportunities for students to "exhibit a tolerance for ambiguity, perseverance and the capacity to work with open-ended problems" (ISTE Standards for Students 4d) come naturally as they "develop, test, and refine prototypes as part of a cyclical design process" (ISTE Standards for Students 4c).

What happens when their program does not work the first time? They need to go back and debug it, rising up from setbacks to continually test and refine their computational artifacts (Core practice 6, K12 Computer Science Framework).

I've also integrated debugging by having my students create debugging challenges in Scratch for their classmates to solve. This involves creativity, collaboration, computational thinking and communication. Students first need to come with an idea for an animation or drawing and then use computational thinking (ISTE Standards for Students: Computational Thinker) to create the program to execute their idea. Then, they must strategically decide which piece of code they will intentionally manipulate to create a debugging challenge for others to solve. Or, as one of my students wrote, "Computer scientists iterate until they achieve what they wanted to achieve!"



Create by connecting to the physical world.

Using physical computing really helps my students connect input to output in a tangible way. By creating kinetic sculptures with Hummingbird Robotics Kits, they connect what they program to the physical world through sensors.

They collaborate in teams to design their kinetic sculptures and each of their creations are as unique as they are. Made from materials such as cardboard, paper clips, scraps of fabric and styrofoam, they brought their creations to life with programming. Throughout the process, they kept a design journal with entries that focused on what they accomplished, challenges they faced and how they plan to overcome their challenges.

Here is a reflection from a team member:

> *If you have an imagination, a computer, and a HummingBird robotics set, you can make anything you want to make. HummingBird Robotics is a series of wires, lights, vibrators, sensors and motors. Throughout all of our series of making the disco room, we ran into a few problems. For instance, making the motor work with the record player was a challenge, because we needed to have a pencil lead in the disc so it will work. Also, we were going to make a whole series of notes on the Piano, and time it to every second to make the song work. Also, our LED lights were ripped, and my group tried to fix it.*

Take a look at a few student projects: Buster the dog, Fruit Ninja Robot and Disco Room Robotics. Collaboration, creativity, problem-solving, and debugging — all right here.

Raspberry Pi is another great way to connect to the physical world. The foundation's mission is to bring the power of digital making to people all over the world. The founders believe, as do I, that the complex problems facing society today and in the future will be solved by people who understand and shape our digital world through innovative solutions.

So, where does one start? With the basics such as:

- Make music using Sonic Pi.
- Build and destroy towers in Minecraft.
- Program Picamera with Python 3 to take selfies.
- Operate a motor.
- Light up LEDs with a button.

After learning the basics, it's then a matter of combining, remixing and synthesizing different skills to digitally make an innovation. Here are some helpful guides at www.projects.raspberrypi.org/en to get started:

- Getting started with and setting up Raspberry Pi
- Getting started with Sonic Pi
- Getting started with Picamera
- Physical computing with Scratch
- Getting started with Minecraft Pi
- Physical computing withPython

Provide students with the opportunity to individually reflect on all the Raspi tools in their toolbox and encourage them to dream. That's how I and a team of educators created selfie-taking roaming robot that tweets out random messages celebrating great work being done in classrooms. Because, in addition to students creating and innovating for themselves, it is critical that they see me, their teacher, modeling what it is to take risks, be creative and be a lifelong learner.

So, whatever happened to Abby, you may ask? I'm happy to report that she did not drop my class. She actually ended up creating multiple computational artifacts including animations, games, art and even a kinetic robotic sculpture with sensors. In fact, midway through the semester, she told me how when her mother started posting links to her projects on Facebook, she rolled her eyes and responded with, "Mom, it's no big deal!" There you have it, the everyday miracles of teaching — witnessing students from diverse backgrounds journeying from "I can't do it" to "I can do it!"

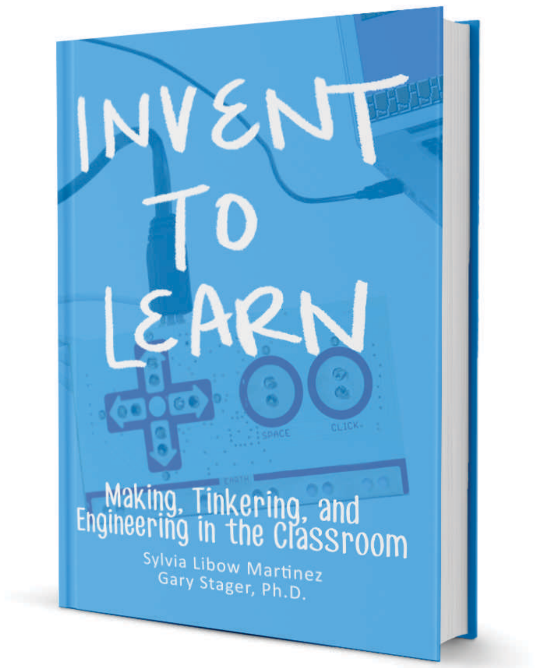
Here's to a year full of empowering our students with many more choruses of "I did it's!"

Janice Mak is an educator from Phoenix, Arizona, and the recipient of the NCWIT Educator Award and Presidential Award for Excellence in Math and Science Teaching. She is co-chair of CSForAZ, a Code.org affiliate, and serves on the K-12 Executive Council for NCWIT, CSTA Arizona board, Arizona State Board of Education and Arizona K12 Center board. You can read more about her classroom adventures on her blog www.supercodingpower.blogspot.com/ and follow her on Twitter @jmakaz.

BOOK REVIEW

Invent To Learn:
Making, Tinkering, and Engineering in the Classroom

Authors: Sylvia Libow Martinez, Gary Stager



SUMMARY

Martinez and Stager remind us of the learning, and the joy, that comes when students have the opportunity to tinker and invent. They also provide a comprehensive outline of game-changing technology for schools, still highly relevant today.

In 2013, when Sylvia Libow Martinez and Gary Stager wrote this persuasive rationale for invention in schools, the modern Maker Movement was still being discovered for the first time by teachers around the world. Many of the tools now familiar in classrooms, such as Makey Makey, Scratch and Arduino, were still bursting onto the educational scene. School makerspaces were growing in popularity, and Digital Technologies was just entering the compulsory curriculum.

But Martinez and Stager foresaw a danger: what if the spirit of the Maker Movement gets squashed in the classroom? What if, instead of students learning *by* Making, the education system turns Making into just another thing to learn *about*?

With State and Federal governments talking up STEM and STEAM, Australian schools now required to implement Digital Technologies curriculum from P-10, and teachers pressed into service to instruct students in coding, this danger seems more real than ever.

After a quick history of educational thinkers who valued invention as a way of understanding, *Invent to Learn* defines the three Ways of Knowing in the book's title; Making, Tinkering and Engineering.

With Making, we become DIYers, using the increasing availability of "transformative materials". We've always had wood and ice-cream boxes, but we haven't always had accessible, fun coding environments, 3D printers, or microcontroller boards so easy to program.

With Tinkering, we play and inquire. Problems are approached through iteration and contemplation, not just linear step-by-step problem solving processes.

With Engineering, we design, invent and build based on scientific principles. For all the lip-service given to STEM, what do the majority of teachers think when we hear the word Engineering? Martinez and Stager write:

> *Unfortunately, we think of engineering as being something very serious one studies at college. In fact, engineering is something that is perfectly compatible with young children. When we encourage children to build with sand, blocks, paint, and glue, we are simply asking them to take what they know about science and apply it to the real world. In the truest sense, children are natural engineers and we can create classrooms that celebrate this fact...*
>
> *... Engineers plan, but they also experiment and tinker. Yet, most kids are deprived of engineering experiences until they endure 12 years of abstractions. (p. 39)*

Those who have heard Gary Stager at a presentation or workshop will know that he is not afraid to critique pedagogical practices that he believes get in the way of, or are extraneous to, student invention.

The book challenges various notions about thinking, justification for the 'A' in STEAM, and the use of popular design process models with school students. Other models, such as TMI

(Think, Make, Improve) are suggested as ways to give students more agency. Practical advice is given on how to best approach and frame school projects.

The book goes on to outline the "game changers" that have emerged; fabrication (such as 3D printing), physical computing (such as Arduino or Raspberry Pi), and programming (such as the Scratch environment). A comprehensive list of school-friendly tech is defined and described, from wearable electronics to CAD software, to choosing a programming language. Since the book was published we have seen some convergence between these technologies, as well as promising and affordable tech options like the BBC micro:bit, but the "game changers" are still arguably unchanged, regardless of the specific product.

The final chapters offer advice on transforming a school beyond just setting up a makerspace, including fostering student leadership.

DLTV is currently looking back 40 years to the first meeting of the Computer Education Group of Victoria (CEGV). Inspired by pioneers like Seymour Papert, teachers across Victoria were fostering Computational Thinking in the 1970s and 80s, with tools like the Logo language (think of the "pen" in today's Scratch).

Students in 2018 have far more experience as consumers of digital technologies. New, more streamlined electronics and robotics kits are appearing, and digital manufacturing through 3D printing and laser cutting has never been more accessible to schools. But the same challenge remains - will our students have a packaged, theory-driven experience of Digital Technologies, completing pre-set tasks to achieve predefined goals. Or will they find the joy of generations of tinkerers before them as they ask, "I wonder what *this* will do?"

Review by Nathan Alison,
Professional Learning Coordinator, DLTV

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