FACING UP TO WICKED PROBLEMS

8.1

DLTV
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Contents

DLTV Journal
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Editorial

Roland Gesthuizen, Matt Harrison, Clark Burt and Natasha Dwyer.
Journal Editorial Team

Community Solutions for Wicked Problems

We are surrounded by wicked problems that are difficult or impossible to solve. Unlike the crisp focus of a school mathematics problem or a convoluted coding challenge, there are many independent factors that weave through a wicked problem that can make it tenacious and frustrating to work with.

Climate change has been described as a "super wicked problem" with multiple and complex causes. The impact of climate change is uncertain and interrelated, confounded by potential solutions to climate change that might well cause further problems. Whilst the need for immediate action is increasingly obvious, action to remedy carbon emissions has been slow, uneven, and politically divisive. Ironically it is also a wonderful opportunity to explore many potential solutions (Saab, 2019).

Consider the paradox of teaching and learning, a delicate balance where schools can maintain a self-contradictory aspiration that "we expect nothing but your best" alongside the belief that "we must all embrace and learn from our failure". Our multiple assessment and teaching goals are often deeply in conflict with each other. Ellsworth (2011) proposed that pedagogy is a wicked problem.

Applied Computing teachers who teach or deploy digital technologies in their classrooms confront the frustration of working through the associated pedagogy or problem of sufficient agency to enable the necessary teaching teaching and learning. Our discipline of teaching does not work through rules or systems but is built upon a passion for learning. The pedagogical design is not linear or scripted but scaffolded through curiosity and inquiry. Pedagogy is in itself a living form anchored in authentic contexts and the real world. As Ellsworth notes, pedagogy requires wicked forms of assessment.

Working from isolation to prepare this DLTV journal issue, it is a good time to hit pause and reflect on the wicked problems of pedagogical design and education for our discipline. We can then design a pathway ahead for a future that is going to look very different to where we are seated today, and cannot be guessed by extrapolating from where we have come in the past. Wicked problems require complex, community-driven solutions that are willing to move away from what has come before.

The articles in this DLTV journal issue can help illuminate this journey.

When exploring general theories of planning, Rittell and Webber (1973) identified ten different properties that we could apply to a wicked problem. It's helpful to reimagine our some of the issues we face in our classrooms

The 10 Properties of Wicked Problems

In 1973, Horst Rittel and Melvin Webber, two Berkeley professors, published an article in *Policy Sciences* introducing the notion of "wicked" social problems. The article, "Dilemmas in a General Theory of Planning," named 10 properties that distinguished wicked problems from hard but ordinary problems. By reviewing these 10 properties through the lens of teaching and learning, we can see the scale of the challenge before us but also the opportunities for transformative practice.

1. There is no definitive formulation of a wicked problem.

Unlike rebooting a computer to refresh or clear an error, if a student does not understand a problem, we don't insist they repeat the same tutorial again and again. Learning is messy.

2. Wicked problems have no stopping rule.

The search for solutions never stops with a wicked problem. The challenge of protecting students and computers isn't about locking down the Internet and securing devices.

3. Solutions to wicked problems are not true or false, but good or bad.

Choosing a solution to a wicked problem is largely a matter of judgment such that the choice of a particular hardware solution cannot be objectively evaluated as right or wrong.

4. There is no immediate and no ultimate test of a solution to a wicked problem.

Solutions to wicked problems can often generate unexpected consequences. For example, walking a student through a solution but this makes it harder to measure or track their learning over time.

5. Every solution to a wicked problem is a "one-shot" operation; because there is no opportunity to learn by trial and error, every attempt counts significantly.

Once your school has chosen to implement a particular learning management system or even a coding language, the decision cannot be easily undone.

6. Wicked problems do not have an exhaustively describable set of potential solutions, nor is there a well-described set of permissible operations that may be incorporated into the plan.

Ordinary problems come with a limited set of potential solutions, by contrast.

7. Every wicked problem is essentially unique.

Knowing how to print a sample exam PDF does not help address the wicked problem of preparing students for an exam whilst conserving paper and copier budgets.

8. Every wicked problem can be considered to be a symptom of another problem.

Wicked problems are often entwined. For example, we may engage students in an online challenge but our activity may include a vendor lock-in that blocks ownership and migration.

9. The existence of a discrepancy representing a wicked problem can be explained in numerous ways.

Stakeholders will each have a different idea about the problem and causes. For example, "learning how to code" is a career pathway for some parents, a creative outlet for some students or a threat to the school network by others.

10. The planner has no right to be wrong.

Problem solvers dealing with a wicked issue are held liable for the consequences of their actions. For example, a decision to prohibit technical support for Wintel, MacOS or even Linux is increasingly harder to justify and has a chilling effect on creativity.

With these 10 properties in mind, we hope you enjoy the articles from our guest contributors and remain optimistic about our ability as educators to address the most wicked problems facing our education system.

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From the President

Ben Gallagher

Following the strange year that was 2020, we all had some combination of anxiety and excitement for what 2021 would hold for Victorian teachers. Obviously the past 18 months have been at times challenging, with five lockdowns leading to rapid pivots to online teaching and learning. Our community has been resilient, recognising our role in leading these transitions and support other staff who may not share our comfort with the technologies and digital pedagogies. What we have seen is a generational transformation of mindset, with the pain of these forced changes holding the silver lining that many Victorian teachers have an increased understanding and appreciation of how digital tools, when used with careful planning, can benefit learning in ways previously unimaginable.

That brings us to this latest issue of the journal which serves as a celebration of the enthusiasm and celebration of the innovation and dynamism of our membership. In this issue you will find a variety of ideas and topics for a world that is increasingly comfortable with the idea of digital pedagogies. In addition to harnessing the affordances of technologies to optimise academic learning, we have also learnt that technologies can help enhance social connections within members of school communities. We have learnt that more than ever, social inclusion is vital for every child and young adult, and that we as teachers can create new methods and spaces for our young people to stay connected in times of crisis.

Digital Learning and Teaching Victoria is proud of our role in help our members stay connected during periods of uncertainty. We hosted our entirely online Australian Council for Computers in Education virtual symposium in April, bringing together teachers, school leaders and researchers across the country for five days of practitioner-lead learning. This successful event will be followed with an increased focus on blended and face to face learning, providing our members with ongoing ways to connect with each other and to develop our professional networks. The year will conclude with our renowned DigiCon conference, returning for the first time since 2019. I can think of no better way to finish the year than to hear from so many of our committed members sharing their stories and learnings from the past two years.

As we move towards the conclusion of 2021, I hope that you have the chance to take a breath and appreciate all that you have accomplished and contributed to education in our state. No matter whether you work in an early childhood setting, a primary or secondary school or a university, we have all grown together and learnt the importance of community. Thank you for playing such an important role, and I hope to see you in the very near future at one of our events.

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

PRODUCT REVIEW

Ned Robotic Arm

The landscape of educational robotics is exciting and ever changing, so it can be a challenge to identify and implement the right robot solution for your educational setting. Each platform will have its pros and cons, and it's important to test and trial before you invest. This is why I am reviewing the Ned Robotic Arm.

What is Ned?

Ned is a French-made, collaborative 6-axis robotic arm that has been designed to bridge the gap between industrial uses of robots and education settings. Ned's 6 degrees of freedom give it the ability to complete similar movements to a human arm. When combined with its conveyor belt system it is able to simulate industry use cases.

Context: Robotic arms & industry

Robotic arms have been an integral part of the manufacturing industry since the '70s and '80s. Large scale robotic arms have been building cars and completing complex tasks in assembly lines for many decades. We're now reaching a point where robotics technology is being used with humans collaboratively. Fulfilment centres for major supermarkets & retailers are an example.

Why is Ned useful for education?

Ned gives students and educators an opportunity to investigate and model industrial uses of robotics. This gives students a real-world context and application for their Digital Technologies and Design and Technologies skills.

From an implementation perspective, students are easily able to transfer their coding skills quickly to Ned – they can use Blockly & Python to program Ned's movements.

For educators and students wanting to create advanced functions, Ned is fully compatible with ROS (robot operating system) and is open source.

If you would like to know more about Ned please feel welcome to contact me directly.

Reviewed by Sam Kingsley
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THE POWER OF PEER OBSERVATIONS

Written by Celeste Pettinella

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As a STEM Education skilled teacher in a primary school, this year I have observed some outstanding lessons from Mathematics interventions groups, Reading intervention program, Maths lessons, NAPLAN revision lessons, dictation and to top it off, even an auction in a classroom! My Peer Observations have started off well. The DETVic (2019) described it as being ".. about teachers observing each other's' practice and learning from one another."

I have been involved in peer observation for many years and the purpose of these observations is to help educators share best practice and build awareness of the impact they have on their own teaching. John Hattie's research (2018) focused on the factors related to student achievement, revealing that collective teacher efficacy has the greatest influence on a student's ability to learn.

Being directly involved in peer observation has provided me with the ability to see the big picture of teachers across the school, which as an inspiring leader is important. As a STEM Educator I am able to connect with all teachers in a professional manner to not just observe somebody teaching in the classroom, but also see how they set up their classroom space and how they share resources with their learners. From what I have learned, it's very complex and highly personal.

Based on my experience working at a variety of schools every school can do peer observations differently, but the purpose is essentially the same. At my current school I am working at a template that has a focus area, observation section, questions spot and takeaways to name a few features on the template where teachers record their notes during the sessions. Whether someone observes you or you watch another teacher teach the feedback component is crucial because it can allow for rich purposeful and authentic discussions with the aim to improve teacher practice that can then have a positive impact on student engagement and learning outcomes.

If done correctly and in a timely manner, I am surprised by what we can learn from each other and fortunate to have been actively involved during my peer observations. Feel free to view the images below that depict some of the amazing observations that I have been engaged with. I would love to hear how other STEM Leaders are doing their peer observations so please feel free to send me a message.

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LOOKING UP THE WEATHER DATA

Gary Bass and Roland Gesthuizen
Mag-Net: Association of Online STEM Educators

Back in 1996, the Mag-Net team established at Monash University, a greenhouse that could be remotely controlled by anybody on the Internet. This innovative project broke new ground, enabling students to appreciate the interactive nature of the Internet for environmental monitoring.

Eltham high school was fortunate enough to get the opportunity to join GLOBE, a worldwide student lead project that was launched on Earth Day, 1995. The GLOBE project is designed to help middle school students collect their own data using GLOBE protocols to share with other GLOBE Schools and participating scientists.

An Automatic Weather Station (AWS) was set up at Eltham High School as a GLOBE inspired project. Remarkably, this AWS has been continuously collecting and logging and publishing weather data on the Internet every day, week, month for the past 20 years! The AWS is completely flexible, fitting in with the existing curriculum and operated by teachers and students. You can directly check out this historic data logger at this web address here: http://web2.elthamhs.vic.edu.au/weather/index.htm

AWS ACTIVITY IDEAS:

give students a ream of weather data from an AWS and they had to guess what day the week or year that the weather was collected, or explorer as a mega-data set. Validate and compare it with data from the Weather Bureau of Meteorology. Consider building your own AWS, what would you use? What environmental data could you record and log then imagine what you could make that could automatically collect and share this?

Now ramp it up by looking to join GLOBE. http://www.globe.gov

David Vantage Pro AWS (stock photograph)

ELTHAM HIGH SCHOOL CURRENT WEATHER CONDITIONS

As of: 30/07/21 9.08pm

Temperature	12.9°C	Wind Chill	12.9°C
Humidity	56%	Heat Index	12.1°C
Wind	N at 0.0km/h	Dewpoint	4.3°C
Barometer	1022.7 hPa	Rain Rate	0.0mm/hr
Today's Rain	0.0mm	Monthly Rain	66.8mm
Storm Total	0.0mm	Yearly Rain	527.3mm

- Detailed current weather data
- Last week's table
- Historical weather data
- Year to date table
- Last year's table

Weather cam looking southwest from Eltham High School

DID YOU KNOW?

By Phill Cristofaro
The iPad Guy
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Apple's Pages app is more than just the equivalent of MS Word? Pages allows teachers and students to create gorgeous looking EPUBs from ready-made eBook templates or build-your-own from scratch. EPUBs are basically eBooks and can be published on a variety of platforms. In terms of Pages, a document can be exported as an ePub or published directly to an audience of 51 countries via Apple Books.

WHY IS THIS SIGNIFICANT?

Excellence in writing is best achieved when students write for an ***authentic audience and purpose***. Through publishing, young writers can be provided with opportunities to write for a global audience. Check out some quality examples of student publishing below (all are free to download via Apple Books)

Convergence: April 13th, 1945

An immersive and detailed collaborative work of historical fiction by four female primary school students.

https://itunes.apple.com/WebObjects/MZStore.woa/wa/viewBook?id=1446852343

Unsolved: A Murder-Mystery with a Difference

This publication is inspired by the game of Cluedo and is highly inventive. You have the evidence…you solve the crime?

https://itunes.apple.com/WebObjects/MZStore.woa/wa/viewBook?id=1491153974

The Three Little Pigs with a Twist

This collaborative student writing project is highly visual and has accompanying audio widgets.

https://books.apple.com/au/book/the-three-little-pigs-with-a-twist/id1456515884

Sally and the Fishies

A student writing project with a powerful message. This illustrates the power of digital drawing.

https://books.apple.com/au/book/sally-and-the-fishies/id1489148672

Exploring Zebras (teacher - Jesse Fisher)

Teachers can be authors as well. This teacher example of a documentary-style text demonstrates the power of teacher-modelling within the writing process. A search of "Jesse Fisher" in Apple Books will result in a rich selection of student-writing projects from Montpellier Primary School in Geelong).

https://books.apple.com/au/book/exploring-zebras/id1517265672

iPads from 2017 onwards (with an A9 chip) that run iOS13.2 or later are able to use AR (Augmented Reality) apps. Augmented Reality is a form of technology that allows the camera to add virtual (digital) objects to the real world in 3D. AR is simple to use, highly engaging and can give students huge scope for investigation. Screen recording on the iPad allows them to make their thinking visible.

TRY THESE FREE AR APPS

Get started

JigSpace - explore everyday science and tech objects and pull them apart **https://apps.apple.com/au/app/jigspace/id1111193492**

BigBangAR - the origins of the Universe told through AR
https://apps.apple.com/au/app/big-bang-ar/id1453396628

Go Further

AR Makr - build your own AR scene to tell a story
https://apps.apple.com/au/app/ar-makr/id1434081130

Build-your-Own AR:

Reality Composer - create your own AR
https://apps.apple.com/au/app/reality-composer/id1462358802

See what educators are doing on Twitter
via the hash tags #AR #iPad

To view these apps, try this link:

DATA CENTRES AND THE GLOBAL ECONOMY

STEPHEN TROUSE B. Eng., Dip. Ed.

is a teacher of I.T., Maths and Physics at Flinders Christian Community College in Tyabb, and the founder of Clearsoft Pty Ltd, a software development company providing bespoke solutions for a wide range of enterprises. He has worked in many and varied roles throughout his career and brings this passion and experience into his classroom and work. He has two beautiful and talented children and considers his greatest achievement the legal right to fly a light aircraft upside-down.

Let's face it, the Internet to our homes now ranks with electricity, gas and water as an essential utility. The pandemic has certainly cemented the Internet's place in the grand scheme of things. However, there are both sustainability and security implications associated with this new order.

As someone concerned for the environment, I have seen it as a good thing that our travel has been curtailed and the Earth has managed to take a breath. However, while air travel contributes around 2.4% to our global emissions, it is astounding to think that running the Internet with its myriad of servers and data centres contributes 3.7%! This may also be increasing in our current predicament.

The BBC article *"Why your internet habits are not as clean as you think"*[1] suggests the IoT may push this even further:

> " The carbon footprint of our gadgets, the Internet and the systems supporting them account for about 3.7% of global greenhouse emissions, according to some estimates. It is similar to the amount produced by the airline industry globally, explains Mike Hazas, a researcher at Lancaster University. And these emissions are predicted to double by 2025."

The BBC article includes a unique way to reduce your carbon footprint, however potentially upsetting the delicate balance of cyber-etiquette. It suggests that emails with attachments can contribute significantly more CO_2 than those without. A regular email contributes 4g CO_2, while an email with a picture in it contributes 50g! Not sending a "thank you" email:

> " ...could save 16,433 tonnes of carbon a year – the equivalent to taking 3,334 diesel cars off the road, according to energy company, OVO." (UK figures)

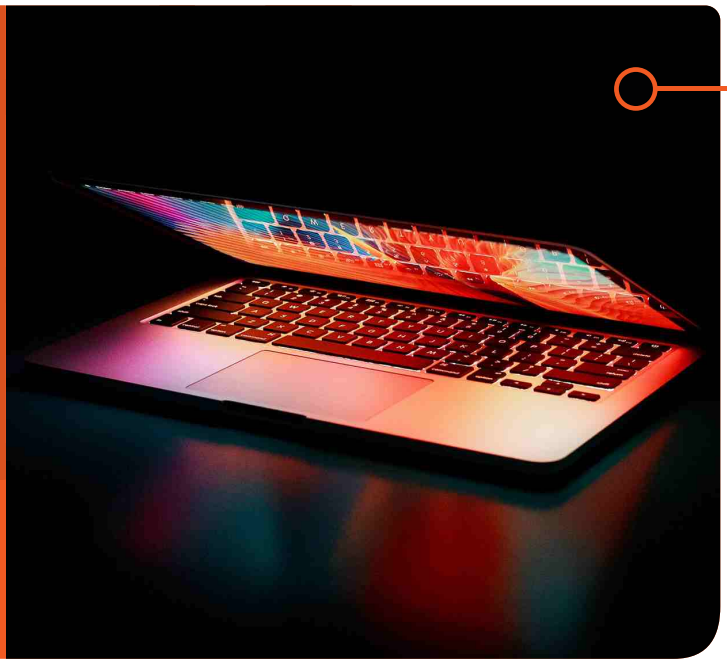
Do we have a moral duty to send fewer emails? Should we keep data on our own machines rather than in data centres (OneDrive, iCloud, Google Drive etc.) where at least we can switch off the machine when not in use?

There are also implications for security in our new ways of working. Data centres do seemingly not pay enough attention to where our cloud data is stored. The big players in this market generally go for the cost-effective option, and given that their servers may reside in a sovereign country where privacy laws are possibly less rigorous, more than our privacy may be at risk. Do we rely on the moral rectitude of the leaders of that country? What is right and wrong for countries who may have expansionist policies?

[1] Timperley, J. (19 Feb 2020). Why your internet habits are not as clean as you think. *BBC*, *https://www.bbc.com/future/article/20200305-why-your-internet-habits-are-not-as-clean-as-you-think*, Accessed 24 Sep 2020

15 MOMENTS THAT SHAPED THE INTERNET

(2021) iiNet Blog



The internet turns 52 this year with no grey hairs in sight. Talk about ageing well! It's given us half a century of delight and distraction with online shopping, instant communication, viral dance moves, memes, and more – forever changing the way we live, work, and play.

So, in celebration of the invisible information superhighway, we've picked out a list of its pivotal moments. Follow along on our nostalgic stroll through the internet's history and, in the comments below, let us know which events you think we've missed.

1936

H.G Wells predicts the 'World Brain'

Perhaps best known as the author of 'The War of the Worlds', futurist H.G Wells foresaw the advent of the internet in a 1936 collection of essays: *"The time is close at hand when any student, in any part of the world, will be able to sit with his projector in his own study at his or her own convenience to examine any book, any document, in an exact replica."* And that wasn't the only prediction of Wells that came true – he also anticipated genetic engineering, lasers, and Meryl Streep as the next James Bond. Okay, maybe not that last one.

1969

ARPANET is switched on

In an event that is widely regarded as the web's 'first breath', Leonard Kleinrock and his team succeeded in sending the first computer to computer message from UCLA to Stanford on September 2, 1969. The intended message was the word "login" but only the first two letters made it through before the system crashed.

1971

Birth of the computer virus

Written by Bob Thomas of BBN Technologies, Creeper was a self-replicating program that copied itself to computers connected to the ARPANET to display the message: "I'm the creeper, catch me if you can!". It was eventually caught by Reaper – the first antivirus program.

1985

Birth of the computer virus

Symbolics.com was registered on March 15, 1985. Since then, over 359.8 million domain names have been registered – including Voice.com, which was sold for a record-breaking $30 million in 2019.

1990

Online searching gets easier

While many of us spent our days at university avoiding lectures and frequenting the pub, Alan Emtage developed a software called Archie, which was the world's first search engine. Clearly the guy you wish you had for your final group project.

1991

The World Wide Web begins

Tim Berners-Lee, a British scientist working at CERN, invents the "World Wide Web" as an easy way to share information. Though we often use the "Internet" and the "Web" interchangeably, they don't actually refer to the same thing. The Internet hosts the Web, which was Berners-Lee's breakthrough.

1992

"Surfing The Internet" is invented

Jean Armour Polly coined the phrase in an article for the Wilson Library Bulletin, a monthly magazine for professional librarians. You can still read the original online here.

1994

First Online Order

A large pepperoni, mushroom, and extra cheese pizza from Pizza Hut is **ordered** online, becoming the first transaction on the Web. No word on how many have been ordered since (but we think it's at least 5).

2001

Wikipedia opens to the world

The beginning of the end for encyclopedia salesmen. Wikipedia launched with its first edit on January 15, 2001, and fast became the go-to source of information. By 2006, the site had published over 1 million articles.

2004

Facebook makes (a lot) of friends

Before it became a platform for your distant family members to comment on your profile picture, Facebook began as a way for college students to connect with people at the same school. It went live on February 4, 2004, and gained 1,000 registered users in its first night.

2007

Apple reinvents the phone

With 91% of internet use conducted through mobile, we couldn't have a greatest hits list without mentioning smartphones. The birth of the modern smartphone began in 2007 on a stage in California as Apple CEO Steve Jobs introduced the iPhone. It was a revolutionary design, swapping a stylus and keypad with a touchscreen.

2009

The Labor Government announces the NBN

The aim was to replace the nation's ageing copper network with optic fibre to give Australian's everywhere a fast, future-proof connection. Here at iiNet, we're proud to be named Australia's Best NBN Provider for 3 years running.

2014

The ALS ice bucket challenge

The ice bucket challenge was a phenomenon in the summer of 2014 in which people filmed themselves dumping a bucket of iced water over their heads in order to promote awareness for amyotrophic lateral sclerosis (ALS). More than 17 million people posted photos online and over $100m was raised worldwide in a 30-day period. A great example of the internet as a force for good.

2019

'Influencer' joins the dictionary

The internet has even changed the way we speak. 'Influencer' is a term used to describe individuals with a large following on social media. Other words in the dictionary that originated online include 'selfie', 'srsly', 'LOL', and 'OMG'.

Today

As of November 2020, there were 4.66 billion active internet users worldwide – almost 59 percent of the global population. Ask any of them what life would be like without life would be like without the net and the answer will likely be either 'unimaginable' or 'very, very boring'. We think both apply.

Jo Borger

Note: this article has been republished with the permission of the author.

Community MEMBERS

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#BridgingTheGap #EdTech
#SkillsForTheFuture #RegionalRepresent

A VERY BRIEF BIO

I am in my fifth year of teaching and currently a Specialist STEM Teacher at Lakes Entrance Primary. I am a GEG (Google Education Group) Leader & Founder for Lakes Entrance & Bairnsdale regions in addition to a Global GEG Leader. I am part of the Department of Education Google Workspace User Community as a support and representative for East Gippsland educators and I am also a Certified Google Trainer and #SYD19 Google Innovator. I am a Mote messaging and a STEM Punks Ambassador and I am also part of the Minecraft Community and this year introduced the senior students to eSports and introduced a Girls STEM Club. I am passionate about using EdTech tools and gamified learning to engage students and bridge gaps, whether it is within the classroom, for different abilities, genders or between Metropolitan and Regional. I am particularly motivated to make a difference for our low socio and Australian Indigenous students.

THE MOST SIGNIFICANT EXPERIENCE IN MY CAREER IS ....

I think truthfully, it is evolving right now, however the instigation would definitely be to become a Certified Google Innovator. Not only because this was an achievement in itself but it created a shift in mindset and opened me up to a PLN, ideals and knowledge and a community of like minded people that I had never experienced before. Particularly coming from a small low socio economic regional town. It strengthened my determination to make a difference.

I WOULD TELL MY YOUNGER SELF....

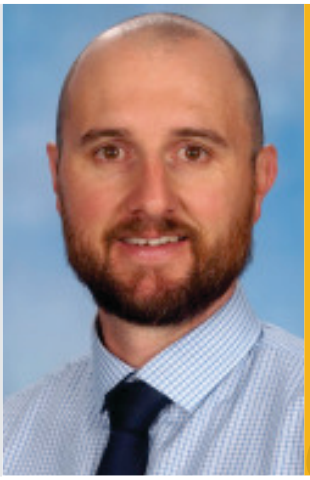
To embrace my "introvert" self and work on strategies to deal with Imposter Syndrome. You do not need to be an extrovert to achieve success but education and networking creates opportunities. Learn to find your voice and create opportunities for connection. Practice gratitude and give back to the community. Understand that everything you do has a purpose and adds value to your journey.

MY FAVOURITE DIGITAL THING IS ....

Whatever is creating engagement, independence, creativity and success for students and their education and for me equally. I am a great supporter of Workspace for Education tools and any compatible tools. At the moment I am really enjoying making use of Minecraft, Microbits and Merge Cubes (with the 3D design elements created in CoSpaces).

WHAT INSPIRES ME MOST ABOUT DIGITECH IS ....

What inspires me most about digitech is the endless possibilities….to be creative, to create change, to create connection, to cater for differentiation and to ignite critical thinking and a problem solving mindset.



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A VERY BRIEF BIO

Geelong born and bred, I have been teaching and leading in schools for 19 years and have taught everything from Year 1 to Year 11, and everything in between. As of July 2021, I'll step in to my first substantive Principal position at Newtown Primary School and look to utilise my 19 years to best impact all the little people who come to my school each and every day. Prior to this, I was a successful Assistant Principal for Curriculum Innovation & Design at Ashby Primary School in Geelong, Victoria.

WHAT INSPIRES ME MOST ABOUT DIGITECH IS ....

What inspires me most about digitech is that it is constantly evolving. As an instructional leader with a passion for effective digital technology integration, I have always marvelled at how effective tech adoption can lead to true transformation of how students learn, apply their knowledge and positively impact others. From the early days of classroom desktops and Apple 2es, to the interaction of iPad devices and mobile technology, and to now Virtual and Augmented Reality, the ways in which that evolution has demonstrated its capacity to impact students and their knowledge, growth and achievement is mind blowing. As educators we have a responsibility to use what we have at our disposal to best support our students, and digitech without question has immense power.

THE MOST SIGNIFICANT EXPERIENCE IN MY CAREER IS ....

every time that I meet a new teacher or school leader who shares the similar passions, thoughts and beliefs when it comes to doing the best we possibly can for our students, their families and our staff. You can learn how to be a highly impactful teacher and school leader, however, having passion for the roles and a love for what you do does not come lightly. When I meet people with

that passion it is without question inspirational! But if I had to select an "actual" one off, it would possibly be Keynoting the 2015 DLTV Conference!

I WOULD TELL MY YOUNGER SELF....

Don't be afraid to let go, give things a try, and never ever be afraid to fail. We learn by doing and to quote a childhood idol in Michael Jordan, "I have failed over and over again in my life, and that is why I succeed."

MY FAVOURITE DIGITAL THING IS ....

(and it is the first thing to come to mind) is my iPad. To be a little cliche', there isn't much I can't do with an iPad--create, collaborate, and communicate, among many other things! All whilst it being portable, easy to use, and tailored to my needs! A close second favourite digital thing is 3D Printers, which are ONLY bound by imagination! ;)

DATA & EMPATHY: PROBLEM DESIGN AT GROK ACADEMY

By Nicola O'Brien
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Grok Academy runs four competitions every year, each speeding students through up to five weeks of online coding tutorials. The interactive core of our competitions are the problems. These allow students to apply the concepts they've just read about, while receiving instantaneous feedback to guide them to a correct solution, all right in their browsers. Each problem is automatically marked, earning students points which rank them in a global leaderboard.

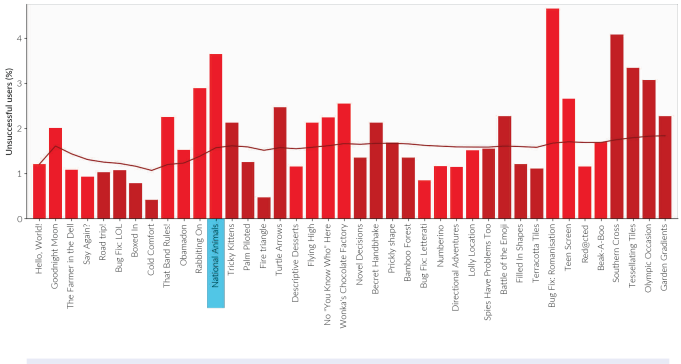
Of the four competitions, two are the NCSS Challenge, a Python and Blockly coding course, and two are Web.Comp, a HTML/CSS coding and web design course. Both of these are further split up into multiple streams, each one aimed at a different ability level. Each of these streams can have up to 40 problems in it. That's over 200 problems across all our competition streams!

How do we keep track of all these problems to ensure we're delivering effective teaching to students? In this article I'll go through some of the ways we assess our problems so we can efficiently maintain and improve our courses.

Measuring understanding

Each problem in the course attempts to reinforce particular learning concepts that are introduced in slides prior to it. So when improving our courses, the immediate question is: how well does a problem help students understand its concepts? That's a difficult question to answer, which only becomes more difficult if we want to answer it for every problem. Where do you even begin?

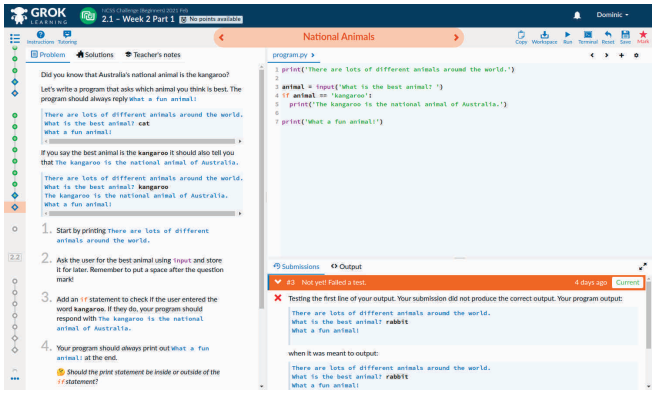
We begin by asking the inverse question: how well do students understand the concepts in a problem? Our systems collect large amounts of data on student interactions with our courses, like when students view problems, when they attempt them, and when they succeed at solving them. Using this data, we create some simple measures of student understanding.



Student failure rates for problems in NCSS Beginners February 2021. Rolling average shown as a line.

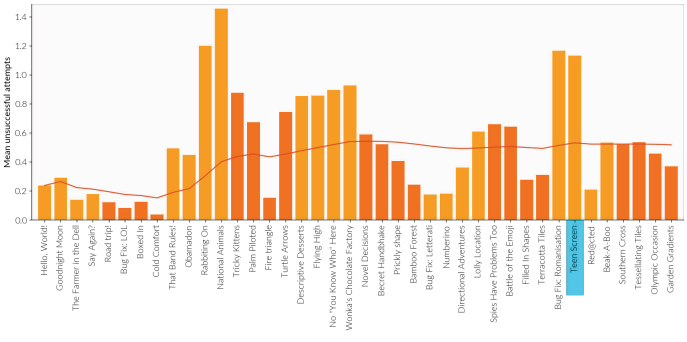
The most basic measure of student understanding is success, or conversely, **failure**. The graph above shows the proportion of students that failed to solve a problem, out of the students who submitted at least once on a problem. We always expect some students will never succeed at a problem — competitions are time constrained and meant to be challenging. But if a problem has a higher failure rate than surrounding problems (when we don't intend it to be especially challenging) then it could indicate that students are giving up out of frustration.

This graph can't tell us why this frustration is occurring — maybe the concepts being tested are just difficult, or maybe we could make them more approachable — but it does let us flag a problem for further investigation. For example, it indicated to us that, among others, "National Animals" from the Beginners February 2021 Challenge needed some attention.



"National Animals" from the NCSS February 2021 Challenge.

One of our feedback mechanisms is the automarking system itself. It not only tells students if their solution doesn't achieve the required behaviour, it also tries to explain what's specifically going wrong and sometimes gives hints on how to fix it. We expect students to use this feedback mechanism to help them achieve solutions, but if students are submitting many unsuccessful solutions, it could indicate that they're trying to brute force the problem because they haven't fully understood the concepts they need to apply.



Problem difficulty in NCSS Beginners February 2021. Rolling average shown as a line.

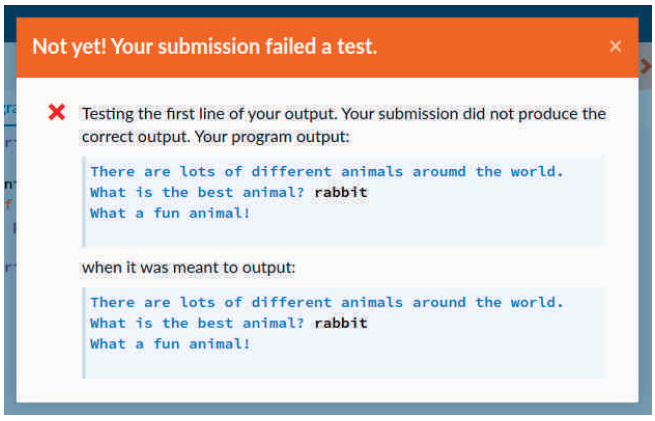
So another measure of understanding is ease of success, or conversely, **difficulty**. To measure difficulty as a metric, we calculate the average number of unsuccessful solutions students submit to each problem, shown in the graph above. Most students actually get a successful solution on their first go, so most difficulties are below 1. Problems with high failure rates tend to show up with high difficulties as well. "National Animals" was already flagged for its high failure rate, and its difficulty is not only far above 1, but far above the average for the beginning of the course. However, some problems with moderate failure rates can still have higher difficulties. "Teen Screen" — which had an only slightly higher than average failure rate — has a much higher than average difficulty, so it got flagged for investigation as well.

Investigating misunderstanding

Once we assemble a list of flagged problems, we investigate them by asking: how does each problem *fail* to help students understand its concepts? This question is, again, difficult to answer, and is likely different for each student. Easier to answer is the inverse question: how do students fail to understand the concepts in a problem?

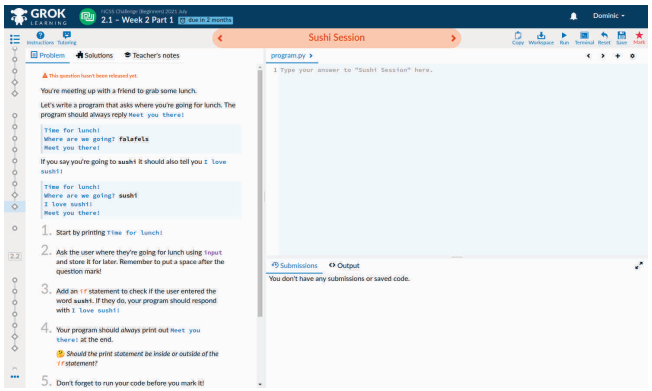
Our approach to answering this question is straightforward: we randomly sample a few dozen students who submitted to a problem — focusing on those who failed or submitted many unsuccessful solutions — and look through their solutions ourselves. We can do this because our systems capture every submitted solution in its entirety, including unsuccessful solutions and even solutions that were saved but not submitted. This approach may seem simple, but it uses the empathy of our educators, and usually illuminates common barriers to understanding quickly.

As an example, we investigated "National Animals", one of the problems flagged in NCSS Beginners February 2021 as having a high failure rate and difficulty. During our investigation, we noticed a number of students making submissions with the correct program structure, but with typos in some of the strings. Trying out one of these failed solutions for ourselves, we saw this was the feedback a student would have been shown on submission:



Automarker feedback for a submission that was failed for having a typo.

Each of these lines of output needs to be written into the program by students. In the example above, while the automarker has helpfully identified the issue as occurring in the first line, and shown what the output is meant to be, that's still a lot of text to compare to find a typo. Even being shown this very specific feedback, a number of students who made similar mistakes went on to change unrelated parts of their program, failing again for the same reason or sometimes new reasons. This problem was designed to reinforce coding concepts, but here spelling mistakes are impeding that. So we rewrote the problem to use much shorter strings — and have a new theme! You can check out the new problem, "Sushi Session", in NCSS Beginners July 2021.



"Sushi Session" from the upcoming NCSS Beginners July 2021 Challenge.

Barriers to understanding aren't always straightforward to identify or resolve. In "Teen Screen", an NCSS Beginners problem, students write a function which determines if someone is a teenager given their age. After the July 2020 challenge, we flagged this problem as having a high difficulty. Our investigation revealed that students were failing to understand how to structure the numerical logic conditions necessary to cover the three possible output cases: teenager, not-teenager and not-an-age. We attempted to resolve this in the February 2021 challenge by adding extra interactive hints to the problem description which break down the process of creating appropriate logic conditions. However, after that challenge, this problem was flagged once again as having a high difficulty. Another investigation revealed that the previous misunderstandings were less common, but new misunderstandings had appeared about the same concept — constructing multiple logic conditions seems to just be innately difficult.

Could we further break down creating logic conditions to aid students? Possibly, but this problem is primarily intended to reinforce concepts involved in creating functions, since those are introduced in the same module, rather than advanced program control, which is introduced in earlier modules. So for the July 2021 challenge, we've rewritten the problem — now called "The Latest Buzz" — replacing the logic condition concepts with string matching concepts. These are simpler to implement and hopefully present less of a barrier to reinforcing the primary problem concepts.

If not, we're always iterating and improving our competitions, and learning how to teach coding better along the way. So there's always next time!

Summary of ACARA's proposed changes to the Australian Curriculum impacting on our members

acara
AUSTRALIAN CURRICULUM, ASSESSMENT AND REPORTING AUTHORITY

Our members might be aware that the Australian Curriculum, Assessment and Reporting Authority (ACARA) proposed a series of changes to the Australian Curriculum that would impact both the Technologies learning areas and the general capabilities. ACARA's stated purpose for revising the curriculum is to 'remove outdated and non-essential content, add new content important for students to learn now and give teachers greater clarity and guidance about what they are expected to teach'.

DLTV hosted a 'feedback conference' in June and submitted feedback to ACARA based on the viewpoints of our members. You can read this submission later in this journal. This article is focused on summarising the changes that we identified as being the most pertinent for our membership, as we want you to feel informed about the changes waiting in the wind.

IN A NUTSHELL

The introductory section to the Technologies Learning Area and the Digital Technologies curriculum have been revised, as outlined below.

Introductory section to Technologies Learning Area

The introductory section of the Technologies Learning Area now has a set of core concepts, in addition to the concepts in Digital Technologies. They share some similarities and are complementary. Digital Technologies has a new concept; however, 2 have been redirected to the Technologies Learning Area.

Digital Technologies curriculum

Listed are the main changes to the Digital Technologies curriculum:

1. Vocabulary – there is a range of new vocabulary and some existing ones have been dropped.
2. New level – Foundation.
3. Concepts – a new concept (privacy and security) has been introduced and 2 (interactions, and impact) have been amalgamated and assigned to the Technologies Learning Area.
4. Content descriptions related to Data collection and interpretation from F to 6 have been removed; however, content in Mathematics has been revised to meet the needs of both Digital Technologies and Maths.
5. Increase in the number of content descriptions to address the new concept (privacy and security) and to improve clarity (some multifaceted content descriptions have been separated to improve clarity).
6. Achievement standards now presented as one paragraph.

CHANGES IN DETAIL

Introductory section to Technologies Learning Area

The learning area has introduced the following 10 core concepts, and each content description in Digital Technologies and Design and Technologies should have a link to at least one of these concepts.

- Creating solutions for preferred futures
- Systems
- Data
- Interactions and impact
- Systems thinking
- Computational thinking
- Design thinking
- Technologies processes and production skills
- Project management skills
- Enterprise skills and innovation

Digital Technologies curriculum

1. VOCABULARY IN CONTENT DESCRIPTIONS

The following is a reasonably comprehensive list of new terms that are in content descriptions. **Note:** Red words belong to the content descriptions in the new Privacy and Security sub-strand. ACARA has indicated that there will be a glossary when the curriculum is finalised.

1–2	Branching, iteration, common tools, trusted adults
3–4	Design criteria, user stories, comparison operators (branching), control structures, variables, conventions, behaviours, trusted adults

5–6	On and off states, multiple alternatives (branching), control structures, variables, design criteria, trusted adults, user stories, passphrase, digital footprint, behaviours, multiple personal accounts
7–8	Integers, spreadsheets and databases, design criteria, user stories, nested control structures, flowcharts, pseudocode, debug, agile projects, behaviours, multi-factor authentication, conventions, phishing, malware, digital footprint
9–10	Structure (markup), presentation (styling), outliers, logical operators, prototype, design criteria, user stories, agile projects, cyber security threats and mitigation, multi-factor authentication, password managers, Australian Privacy Principles, digital footprint

The following terms are no longer in content descriptions. Note: some terms still appear in other areas of the documentation such as aims, band descriptions and elaborations.

- information systems
- functional requirements (part of design criteria)
- non-functional requirements (part of design criteria)
- environmental/economic/social/technical constraints
- sustainability
- innovative

We hope this summary helps you to understand what is proposed, and how our national curriculum body sees the future of our learning areas and the skills our students will need in the coming years. Please also read the submission that we made after extensive consultations with our community and let us know if you would like to be involved in any future reviews.

- protocols (ethical, social and technical) – replaced with conventions and behaviours

2. FOUNDATION LEVEL

All learning areas/subjects will have Foundation (F) as a separate level. In Digital Technologies there are 3 new content descriptions plus the data collection and interpretation content description stated in Mathematics (Statistics) in Foundation. The new content descriptions relate to digital systems, data representation and privacy and security ('identify some data that are personal and owned by them').

3. CORE CONCEPTS

There have been two changes:

- a new core concept in Digital Technologies – privacy and security
- transfer (and then amalgamation) of two Digital Technologies concepts (interactions, and impact), to the Technologies Learning Area set of core concepts. This still means that they have applicability to Digi Tech.

The concept of *privacy* and *security* is new to Digital Technologies. According to the introduction to Digital Technologies this concept is defined as 'the protection of data when it is stored or transmitted through digital systems'. However, according to the Introductory statement about sub-strands, it says, 'Considering privacy and security involves students developing appropriate techniques for managing data, which is personal, and effectively implementing security protocols'.

The two concepts of *interactions and impact*, previously listed as belonging to Digital Technologies, have now been assigned to the Technologies Learning Area and have been amalgamated (interactions and impact: meaning … when creating solutions; this involves examining the relationships between components of systems and the effect of design decisions).

The following table lists the proposed core concepts for the learning area and Digital Technologies.

Technologies Learning Area	Digital Technologies
• Creating solutions for preferred futures • Systems • Data • *Interactions and impact (previously in DT)* • Systems thinking • Computational thinking • Design thinking • Technologies processes and production skills • Project management skills • Enterprise skills and innovation	• Digital systems • Data representation • Data collection • Data interpretation • Abstraction • Specification • Algorithms • Implementation • *Privacy and security* (new)

4. REMOVED CONTENT DESCRIPTIONS (F–6)

The content descriptions relating to 'collecting, managing and analysing data' (or the second content descriptions in the Data and information strand in the Victorian Curriculum) F to 6, have been removed, though not forgotten! As there was a significant level of overlap between Mathematics and Digital Technologies with respect to data, the updated ACARA website will provide a link from Digital Technologies to the relevant Mathematics content descriptions, and this should highlight the complementary nature when teaching data.

Following is the Mathematics content description for Foundation: 'collect, record, sort and compare data represented by objects and images in response to investigative questions relating to familiar contexts', and this replaces the Digital Technologies content description (F–2) 'collect explore and sort data, and use digital systems to present the data creatively'.

5. CHANGED CONTENT DESCRIPTIONS

Listed are the main types of changes to content descriptions.

- an existing content description has been altered to improve clarity, such as:

Existing (9–10)	Proposed (9–10)
Plan and manage projects using an iterative and collaborative approach, identifying risks and considering safety and sustainability.	Plan, manage and document individual and collaborative agile projects accounting for risks and responsibilities.

- one content description becomes 2 for the purposes of clarity, such as:

Existing (7–8)	Proposed (7–8)
Analyse and visualise data using a range of software to create information and use structured data to model objects and events	Analyse and visualise data using a range of software, including spreadsheets and database, to draw conclusions and make predictions by identifying trends
	Model and query the attributes of objects and events using structured data.

And

Existing (5–6)	Proposed (5–6)
Plan, create and communicate ideas and information, including collaboratively online, applying agreed ethical, social and technical protocols	Create, locate and edit content for, and communicate with, a specific audience, selecting appropriate tools and using their advanced functionality and storage conventions
***Note**: the above content description addresses create, communicate and collaborate in the one content description*	Share information, plan and collaborate with others demonstrating ethical and agreed behaviours, supported by trusted adults.
	Note: The first content description focuses mainly on create and communicate, with the second focusing on collaboration

- new content descriptions to support the new concept: privacy and security

Existing (1–2)	Proposed (3–4)
Access their school account with a recorded username and password to access their own information *(security)*	Access their school account using a memorised password and explain why it should be easy to remember, but hard for others to guess *(security)*
Discuss that some websites and apps store their personal data online *(privacy)*	Identify what personal data is stored and shared in their online accounts and discuss any associated risks *(privacy)*

6. ACHIEVEMENT STANDARDS

The proposed revised curriculum no longer articulates the achievement standards associated with the two strands in separate paragraphs (one for knowledge and one for skills). This is to indicate that when students are creating digital solutions they draw on both knowledge and skills. For example, the first sentence in the proposed Year 8 standards is quite upfront about student expectations:

> '… use computational thinking to independently and collaboratively create effective digital solutions measured against negotiated success criteria.'

This compares with the existing first sentence:

> '… distinguish between different types of networks and defined purposes.'

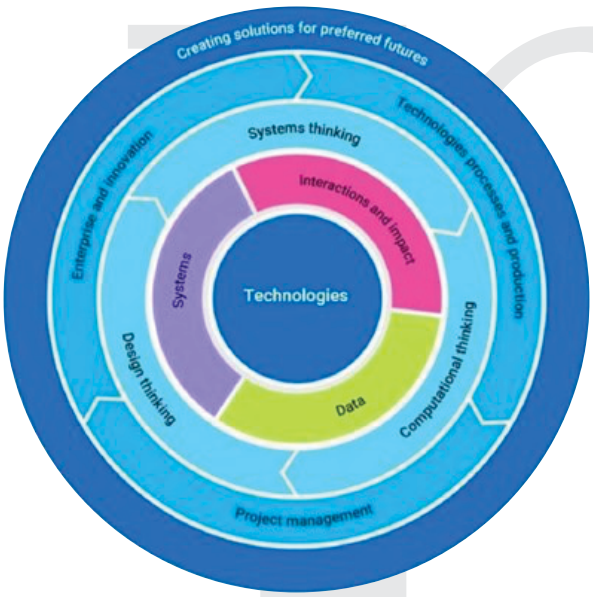


***Figure 1**. Overview of Technologies core concepts*

Note: ACARA has provided a set of curriculum documentation related to consultation, available at: https://www.australiancurriculum.edu.au/consultation/technologies/

DLTV's response to the proposed ACARA curriculum changes

Prepared by the Committee of Management for DLTV in consultation with our members

Digital Learning and Teaching Victoria (DLTV) provided it's members with the opportunity to complete a qualitative online survey, which was followed by an online feedback conference. The online conference involved an overview of the substantive changes to the curriculum and then participants joined either a Primary focus group or Secondary focus group to provide feedback on specific components of the proposed changes. Responses were collated, de-identified and analysed with implications for all Primary and Secondary teachers. Recommendations based on these discussions were then formulated and submitted to ACARA. What follows is a summary of the responses and recommendations.

Members commented on some of the improvements they felt the proposed Curriculum brought to the teaching of Digital Technologies and Digital Literacy especially in content descriptions where, 'there are more detailed and descriptive words to outline what students need to do.'

The inclusion of Sustainability as an area embedded in the aims and rationale of the curriculum was welcomed. 'The digital media industry is responsible for a high level of carbon emissions, and young people will want to be part of the solution.' Members stressed this important area would be strengthened by being explicitly stated in relevant content descriptions and elaborations. In a similar vein, although a welcome inclusion as a core concept, teachers would struggle to include Enterprise Skills and Innovation in teaching programs without content descriptions and elaborations.

Another welcome addition was the sub strand of Privacy and Security. Members were alert to the fact that this area at a school level would need consideration given to potential overlap with Health and Physical Education as well as the Personal and Social and the Digital Literacy general capabilities.

The crowded curriculum was somewhat addressed by assigning data collection and interpretation content descriptions to Maths. Elaborations should be developed for the content descriptions assigned to Maths to illustrate the Digital Technologies context.

It was commented that, 'the language in the proposed curriculum is very dense and IT specific.' and, 'It would be challenging for teachers who are out of field as many primary teachers are generalists'. In particular, respondents asked how the proposed curriculum explained Computational Thinking effectively to teachers to make sense of CT and facilitate students' CT skills. Additionally, 'all teachers should be embedding aspects of the Digital Literacy general capability in their teaching and learning programs.' It was felt that there is a lack of skills and teacher training in the Digital Technologies learning area and this impacts on the delivery in many areas. According to members, 'There is a great deal of content to get through. Most secondary schools only provide a semester long subject (7-10), which is 2-3 classes a fortnight.'

To address these areas of concern, a prominent point of agreement amongst the participants was that a support document such as the UK's 'Computing at School', be developed.

It should include:

- Student work samples
- A glossary with examples
- School stories
- Lessons plans
- Semester teaching and learning programs
- Published school stories to illustrate how the content could be covered at a school level

Members' opinions were mixed in the Data Representation (secondary). Some members wondered about the value of teaching Binary Numbers and concluded that it is a, 'Very dry topic' and questioned its usefulness in wider society and further careers. Others felt the inclusion of Binary provided students with an opportunity to intellectualise content as well as providing students an insight into how manipulation of data can be achieved due to compression algorithms.

The Primary group had a good deal of discussion on the F-2 levels. They certainly welcomed the inclusion of content into Foundation and felt the flow across the levels was sequential. However the 'jump' from Foundation to levels 1 and 2 could be improved by including some content descriptions at Foundation as stepping stones to building conceptual understandings into levels 1 and 2. Additionally, some of the proposed content descriptions that are currently not in Foundation level, but appear first in Levels 1-2, could be written simpler and added to Foundation. Language used in Achievement Standards at this level should not be ambiguous or have room left for any confusion in interpretation.

Another thread in the Primary discussion revolved around the evidentiary research base that would demonstrate a link to the Early Years Learning Framework (EYLF). A question raised was, 'Is the alignment between EYLF and Foundation evident?' and, 'is the content achievable given that the EYLF has minimal guidelines for children's use of technologies/digital competency?'

The process was certainly a rewarding and collegiate experience and we look forward to further involvement and of course, the eventual publication of the next Digital Technologies and Digital Literacy Curriculums.

A Wicked Problem:

Narrowing the Curriculum in a COVID context (2021)

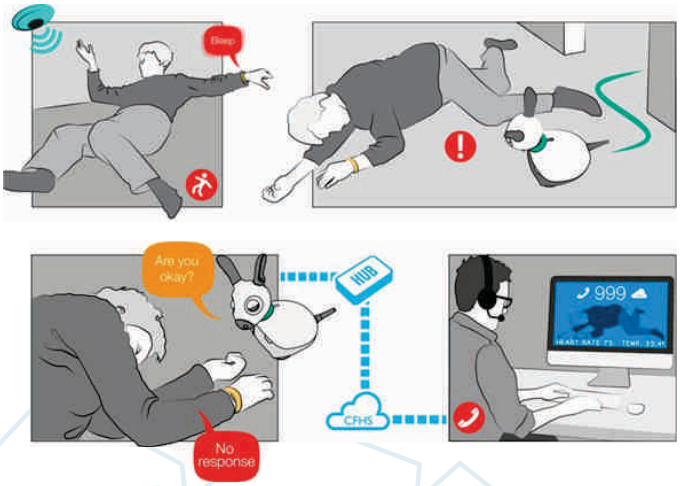
by Leissa Kelly

Leissa has a long-term involvement in science education practice and research, and in community and professional education and training. Her work has primarily focused on environmental education, and STEM (including medical) education. She likes rainy days, hot chocolates, walking along the beach with a dog - and playing with robots at The Brainary.

In this article the Brainary's STEM Education expert Dr. Leissa Kelly examines the narrowing of the curriculum in response to the COVID 19 context and the impact that it has had on the Digital Technologies learning area.

The Future

It has long been recognised that the growth of new technologies, and the subsequent rise in new industries, has led to an increasing need for STEM expertise in the workforce (NSW Govt, 2020). In the report, ***100 jobs of the future***, Tytler et al (2019) unpack this further by identifying the skills that will be increasingly valued in the future workplace. Their findings indicate that all jobs will need digital skills, and STEM / STEAM skills are likely to be the basis of much of the changing economy. Interpersonal skills will also become increasingly important as machines take over more of the routine jobs, there will be a need for people to work creatively at the human-computer interface. "The general view is that people, in future jobs, need to be working with machines, rather than competing with them" (Tytler et al, 2020:4).



Curved Ball

However, COVID has certainly thrown us all a curved ball. No matter how hard we have tried to keep our students inspired and motivated to learn during the seemingly endless periods of COVID isolation, oftentimes we have not been able to address the disparities in learning that have resulted from the disruptions to schooling. Now most of us are back in the classroom, the full extent of the problem is becoming clear as we see all of our students have had their learning and social development disrupted in some way. This lapse is being reflected in behavioural problems that we see exacerbated by student frustration, poor self-esteem and general re-settling into the classroom.

Discussions about the impact on learning achievement have resulted in departments (such as the Victorian Department of Education) allowing schools to 'catch up' on this lapse in student learning by narrowing their curriculum to focus on literacy and numeracy. As teachers struggle with catching up by addressing the gaps in these core areas, we see subjects that are not mandatory being sidelined.

Technology (including coding), art and music are some of the engaging and social activities that students spend less time doing. This could be a mistake, according to Monash University researchers Fiona Longmuir, Kelly-Ann Allen and Christine Grove (2020), as these are the experiences that are most likely to foster belonging, connection and engagement - and it is this sense of belonging at school that drives a student's academic motivation. '*Schools offer ideal places to build a sense of belonging in students – not only through the presence of relationships and opportunities to belong to groups to build social identity, but also through the teaching of social and emotional competencies that serve as the building blocks for social belonging and learning*' (Longmuir, Allen and Grove, 2020)

Coding and Digital Technology

In the classroom, getting the students to work in teams to code robots are ideal ways to engage the children's interest and imagination, to build a sense of identity within the team, and to develop feelings of belonging. Coding robots such as MiRo-E to behave as a therapy dog or Fable to play soccer, can also instil feelings of achievement that lead to improved self esteem and positive behaviour. In addition, coding fosters the development of executive functioning skills, such as problem solving, planning and mathematical thinking, and teaches computational thinking and programming abilities.

There are many opportunities to learn more about digital technologies and how they can be used to teach anything that captures a student's attention and appeals to their interest. The ACARA Digital Technologies in Focus (DTiF) project highlights some great examples of school projects that have adopted a cross-disciplinary approach to address literacy and numeracy concerns and teach coding, while still making it a fun and enjoyable learning experience for their students (ACARA, 2021). For example, Mogo Public School (NSW) uses block coding in Minecraft Education Edition to help students with literacy, social skills and problem-solving. The program also has the benefits of building visual programming skills, developing online etiquette guidelines and fostering positive behaviours.

But Now...

The disruptions to schooling have created problems in achieving learning objectives, particularly in the fields of literacy and numeracy. But in reviewing the literature, it does not seem logical to focus on these areas to the detriment of non-mandatory subjects. By adopting a cross-curricular approach we can teach fundamental subjects through digital technology and, in doing so, can provide opportunities for students to develop a sense of wellbeing and belonging, and to build on their emotional and social capabilities that they will need in the jobs of the future.

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Professional collaboration, enhancement and provision of inclusive STEAM practice for students with disabilities and additional educational needs across Victoria.

By Janelle Campbell
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PARTNERSHIP

Monash Tech School is one of 10 Tech Schools throughout Victoria. Its aim is to give secondary students in the City of Monash the opportunities to access and excel in the area of STEM and to build a foundational understanding of design thinking, innovative technologies and local industry. As a centre of excellence, Monash Tech School delivers programs to 11 partner schools in the Monash LGA; including three specialist schools.

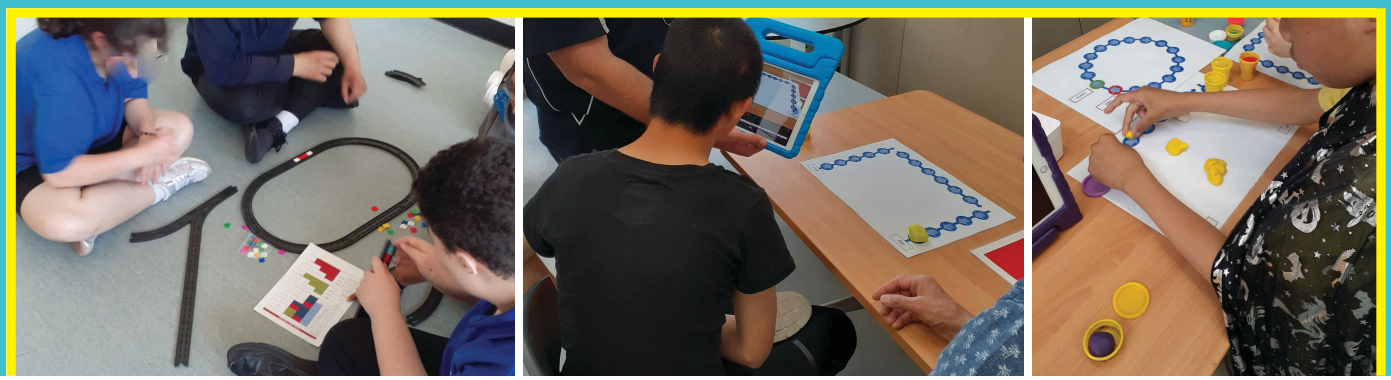
Along with expert science and technology support staff, Monash Tech School employs specialist science, maths and digital technology educators and has recognised the importance of engaging with expert special education teachers to inform and enhance their special education teaching practice and delivery of programs. The Special Education program is an integral part of the Monash Tech School's suite of offerings to specialist school partners.

Over the past 18 months Monash Tech School and the Victorian Department of Education and Training has supported the development of an inclusive STEAM project. The aim of the 'Enhancing Access for Specialist Schools Communities' (ESSAC) project has been to connect Monash Tech School's specialist partner schools through STEAM teaching and learning; enhancing STEAM with innovative technologies, targeted and inclusive STEAM modules, and a STEAM Creator Card Deck to assist with inclusive, collaborative teacher planning. Teacher professional development and collaboration days were also used to develop the project and build a Community of Practice to assist with the continuation and sustaining of expert teacher practice in STEM across all 3 schools. The STEAM Community of Practice includes Monash Special Developmental School, Ashwood School and Glenallen School. Teachers from these schools also contributed to the 29 STEAM modules that are now available for teachers across Victoria through FUSE and the Monash Tech School website.

The EASSC project has delivered inclusive STEAM teaching programs, modules scaffolded with the design thinking process, technologies and specialist expertise to our specialist school partners. The modules have been written to support teachers and student learning as well as include real-world problems drawn from Victoria's priority sectors to promote age-appropriate STEAM learning. The cohort of secondary-aged students who have participated in the programs are students with disabilities and additional learning needs; with varying levels of support required for them to successfully access the technology and learning.

The modules also reference pre-assessment through the use of the Victorian Education Department's ABLES assessment tool to gain greater insight into the zone of proximal development for students' readiness to learn. Conveniently, each module has its own scope and sequence based on the subjects covered, a teacher observation assessment tool based on exploration, engagement and independence and, further suggestions of summative and formative assessments in the module to assist teachers with assessment ideas.

Monash Tech School recognises the significance of the EASSC project for enhancing STEAM opportunities for students with additional learning needs, as well as the importance of sharing their expertise about inclusivity. In addition to this, Monash Tech School staff have participated in professional development from AMAZE about Autism Spectrum Disorder as well as the development of webinars, delivered by the MTS Lead Specialist Teacher. These webinars have been shared with all ten Tech Schools to ensure that the work is shared across Victoria. Combined, these elements have and will continue to support Victorian Tech Schools to deliver programs tailored for their specialist school student cohorts and increase disability inclusion across Victoria.



PROGRAM

Monash Tech School has delivered onsite incursion programs for its specialist school partners during the second half of 2019 and through 2020. Due to the constraints of COVID-19 the program ran as many programs as possible throughout 2020. The programs have tested the modules created by Monash Tech School considering student exploration, engagement and independence. Surveyed students reported an overall satisfaction rate which has exceeded 90% over the life of the project.

The innovative and differentiated STEAM modules are scaffolded using the design thinking process and based on real world problems using the 10 key Victorian Government Priority sector industries:

- Creative Industries,
- Medical and Pharmaceutical Industries,
- Construction Industries,
- Professional Industries,
- Food and Fibre,
- Space Industries,
- Energy and Sustainability
- Digital Technologies,
- Transport Industries,
- Visitor Economy.

The range of industries and technologies gives teachers and students greater scope to solve real world problems, use the design thinking process and investigate different technologies. The modules incorporate industry related topics such as creating a fitness tracker, understanding body systems using augmented reality, designing an autonomous vehicle, understanding marine health and marketing for Victorian Tourism, just to name a few. The modules have been broken down into areas of the design thinking process so that students can gain different perspectives and skills when making, creating and problem-solving. The modules are adaptable and can be taught over a term or in a shorter time period.

The programs that have been delivered to Monash Tech School's specialist partner schools, focused on the structured exploration lessons of the modules including coding, robotics, augmented reality, film making and engineering drawing. When guided and supported by teachers, structured exploration is where the students can begin to build on the first stage of the design thinking process: empathy by interacting with the technology, each other or the beginning reasons for the STEAM lesson. When students continue on with the modules they are exposed to opportunities to explore the design thinking process: define, ideate, prototype and test, leading to solutions to real world problems as well as practicing and enhancing their STEAM skills.

During the delivered programs, the students have had a lot of fun exploring technologies such as Sphero Specdrums and Sphero SPRK+, LittleBits, Cubetto, BeeBots, Fable from Shape Robotics, Ozobot EVO, Circuit Scribe, Merge Cube and apps such as Chatterpix and PuppetMaster. A major consideration for the modules and the choice of technologies is inclusivity and to give the teacher examples of how they might adapt the lesson to increase accessibility of the products and the lesson for a range of students. The modules are written as levels A to B, levels C to D and levels F to 1 of the Victorian Curriculum; encompassing products and processes that can be simplified for access and then gradually increased in difficulty to extend student abilities such as screen-free elements to robotics, tactile visual coding, visual coding with Scratch, and easy and intuitive construction and design of products.

OUTCOMES

Twenty-nine modules, focused at level A to level 1 of the Victorian Curriculum, have been created to increase inclusive STEAM participation of secondary-aged students with additional learning needs across Victoria. The inclusivity of the modules developed for the ESSAC project encourages adaptation to meet individual learner needs through examples of differentiation, flexibility with the timing of lessons and curriculum level specific modules. These modules can be accessed through the Monash Tech School website and through FUSE.

To encourage partner school teachers to build on their own STEAM teaching capacity and collaboratively plan inclusive STEAM lessons at their own schools, the STEAM Creator Card Deck was developed by Monash Tech School to assist in increasing teacher understanding and use of the design thinking process, with a focus on local Victorian industry and inclusion. It is an easy process to use the planning card deck, with a teacher from Ashwood School saying "I really like the STEAM Creator Card Deck, for someone who doesn't immediately think scientifically or with the design thinking process, it is a winner." The card deck is also available for purchase through Monash Tech School for schools interested in design thinking, industry and inclusive STEAM planning.

Teachers at Monash Tech School's specialist partner schools were also impressed with the enthusiasm and engagement from their students using a range of new technologies. They were thankful for the successful program; "We were very fortunate to be a partner school in your exciting plan. Our students would not have had the opportunity to use the amazing equipment without your vision and expertise in STEM." They also liked the hands-on nature of the STEAM sessions and the special education expertise saying, "Having an experienced special education specialist attached to Monash Tech school has proven to be a great asset as [Janelle] has a deep understanding of the needs of our students and the teachers working in specialist schools." The students participating in the sessions also were excited to share their involvement with their parents, at assemblies and talking with their teachers:

"The merge cubes are like magic things. You can make a copy of the same thing."

"It's interesting what the science stuff can do."

"We had this thing on our finger and we could make music."

"It was fun because we had an app on an iPad and there was a sort of keyboard that played different sounds when we touched the colour. We had texta colours, sticky notes and icy pole sticks and they all made different sounds."

To further the expansion of the project, Monash Tech School provided professional learning webinars for seven Victorian Tech Schools to generate connection and application of the STEAM modules available as well as the STEAM Creator Card deck. The Tech School staff were impressed with the modules created for students at specialist schools and their link with design thinking and industry, as well as the opportunity to use the STEAM Creator Card deck to collaboratively plan with their partner schools. The Tech schools were appreciative of the practical information provided during the webinars and the ability to use it as a catalyst for improving or beginning their own relationships and programs with their specialist partner schools.

Monash Tech School will continue to support their specialist partner schools and Victorian Tech Schools through a professional learning network and the continuation of Janelle Campbell as the Specialist Education Advisor. We will continue to contribute to the professional collaboration, enhancement and provision of inclusive practice of STEAM for students with disabilities and additional educational needs across Victoria.

The 29 modules can be accessed through the Monash Tech School website: https://www.monashtechschool.vic.edu.au/specialed and the STEAM Creator Card Deck can be ordered through the website.

For more information about the modules or the STEAM Creator Card Deck please contact Janelle Campbell: Janelle.Campbell@monashtechschool.vic.edu.au

Everyone can play: creating inclusive Minecraft communities

By **Dr. Matthew Harrison** (Melbourne Graduate School of Education) and **Dr. Kate Ringland** (University of California Santa Cruz)

Minecraft is a cultural phenomenon, transcending its humble beginnings as an independently developed game to become the highest selling game of all time with sales exceeding 200 million copies. While not inventing the open world 'virtual Lego' sandbox genre, it popularised the idea of collecting resources and crafting a world limited by only the creativity of players. For many players, this game is predominantly a social experience as people come together on dedicated servers to plan, build and interact in these shared worlds. It is this freedom and sense of expression that has appealed to a broad range of players that challenge the stereotypes of who counts as a 'real' gamer. But despite a diverse audience some players still face barriers in feeling welcome playing Minecraft with others in online spaces.

Over the last few years Matt and Kate have often been asked how server administrators can ensure that Minecraft is an inclusive space, particularly for gamers with disabilities and neurological differences. In this article we will share our insights gained through our research of inclusive Minecraft servers. This is a collation of experiences from a number of research projects. This includes work within the Autcraft community (www.autcraft.com), which is dedicated specifically for autistic players and their families. You might be just considering setting up a server or you may already have a flourishing community. Some of these are observations of the researchers, while others are suggestions from disabled and neurodivergent players.

Kate's research office in Autcraft, an inclusive Minecraft server for neurodivergent youth.

Agency allows players to opt in to play

Minecraft as a platform offers a lot of different ways to interact and play. For example, one player might want to build large structures, another might want to just dig holes, and yet another might just want to hang out and chat with friends. All of these varied activities and forms of play can happen simultaneously within a single Minecraft world. Players can decide on play or shift according to their current whims or what else is happening in the world.

Others within the Minecraft play space also offer different options for players. For example, a group of children may collectively decide to play a role playing game or build a castle (or both). These choices are not only supported by the game, but also by the other people within the community. Administrators, moderators, and other community helpers can also play a role in offering and helping players choose play activities. In Kate's research on the Autcraft, she saw parents actively inviting players to come play games like hide and seek, but ultimately leaving the decision about whether to join in or not to the players themselves. The plethora of choices when it comes to play help empower individual players.

Suggestions for supporting agency in play:

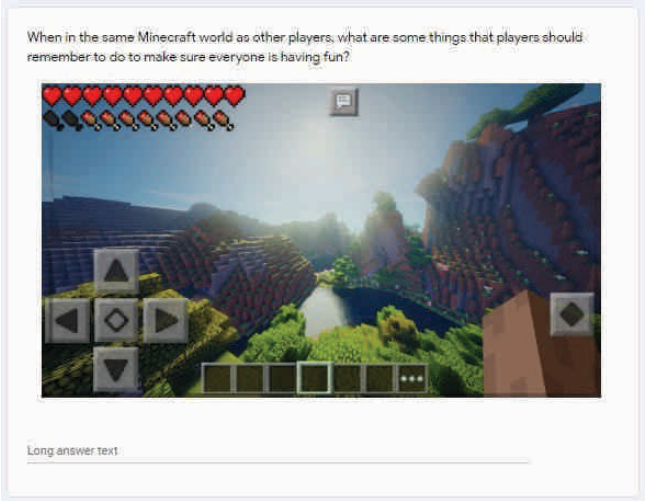
- Minecraft can be structurally built to create choices for the players. Communities can offer a number of different play options and games within Minecraft to give players the benefit of playing how and when they want.
- Community helpers are there to offer choices to players. If a player seems uncertain of what to do, community helpers can describe the various options (such as, "Do you want to play hide and seek today? Or would you like to go build a castle?").

Some players just enjoy watching others interact from a distance until they feel comfortable within the community

Democratically deciding the community values

A key part to developing an online community is deciding on the values and expected behaviours that should inform the way players interact with each other. One practical method for democratically developing 'rules that work for everyone' is to survey the playing community and then use the responses to co-construct an expected behaviours matrix. This not simply the server administrator asking players for input, but rather a 'start to finish' exercise in co-design through which the community feels a sense of ownership over these values and expectations.

In deciding on the initial community values and expected behaviours, server administrators should want to avoid pre-emptively steering community members towards particular responses. Open ended questions framed around the game and harnessing the language of positive outcomes provide one means of doing this. As shown below, players completing this survey are asked to consider "When in the same Minecraft world as other players, what are 'some things that players should remember to do to make sure everyone is having fun?"



Surveying players can help ensure that the rules align with the values and expectations of community.

Suggestions for establishing community values and expected behaviours:

- Values and expected behaviours for an inclusive server should be democratically decided by all of the players. Voice really does matter.
- You can provide a range of ways for players to enable their voices to be heard throughout this process. Examples include offering a written survey augmented with visuals, or a video conference community forum to help facilitate what works for your particular community. The goal is for players to be able to share their suggestions using whichever channel of communication they prefer.
- Using open ended questions to 'step back' and allow players to draw on their experiences and expertise in playing in online spaces. We want to avoid narrowing the focus of the conversation and to avoid pushing players down a particular path of thought.

Supporting alternative modes of communication (both verbal and non-verbal)

Understanding the different areas of strength in communication and preferences for alternative modes of communication is key. Matt has worked with students who prefer almost entirely verbal forms of communication, augmented with the occasional non-verbal cue such as pointing in the physical environment or emoting in the virtual space. He has also met students who are the complete opposite in their communication preferences. A particularly interesting observation from his own research has been that autistic gamers who prefer non-verbal modes of communication in other contexts, such as Maths class, can be much more vocal when playing their favourite games with their

peers. There are a number of possible explanations for this. Perhaps it is having a pre-established vocabulary and a familiar context in which they can use it. Many of his students regularly watch Twitch streams of high-profile gamers playing and discussing the technical elements of Minecraft. This modelling of expression and syntax could contribute to them feeling more comfortable in expressing themselves verbally.

Suggestions for supporting alternative modes of communication:

- Enable an inclusive communication culture by explicitly listing the multiple ways through which players might choose to engage with each other, and celebrate these differences. Examples include voice chat, text chat, and using video chat to allow the use of sign language or visual communication devices.
- If playing remotely, create signs at spawn (starting) points providing ideas for the different ways that players might want to communicate with other players. You can also model language here that can be used in the text chat. You can ask community members to also share their examples.
- Dedicated 'Community Helpers' can be trained to help facilitate different methods of communication, and to initiate conversations with new players to support them in communication with other members of the community.

YellowCraft is a server run 'by and for' autistic girls and women in Australia encouraging multiple modes of communication.

These suggestions are just a starting point for considering how you can make your Minecraft server a more inclusive space. The most important thing that we have learnt along the way is to listen to all of your community. Sometimes you will need to be proactive and ask your players for suggestions as to how your server can better support them and meet their needs. We know that creating inclusive servers can take a little more thought and time to get right, but we have also seen the incredible communities that have built up around these servers that allow everyone to play and feel like they belong.

INTRODUCING

PANGAEA MINDS

By Peta Estens

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Pangaeaminds.info

Pangaea Minds is an internationally award-winning new EdTech solution connecting educators and students around the world using virtual world technology. I founded Pangaea Minds to give the next generation a better chance of solving, through collaboration, the complex global issues our current leaders are grappling with. Pangaea Minds is a pathway for Primary and Secondary schools to nurture global citizenship through fostering real-world ongoing and long-term international partnerships. Pangaea Minds was inspired by my research from the Master of Visualisation Simulation and Immersive design at the University of New South Wales and the Master of Education (Research) at the University of Sydney. Virtual world campuses are technologies to combat the limitations of webcams and online learning systems and Pangaea Minds is an immersive framework for educators and students to collaborate on a global scale.

Schools are often not structured for students to experience an international collaborative environment. Schools mostly operate as local silos. Currently, we raise students in nation-state systems when we need to be developing their capacity to think globally.

I grew up on a remote farm in New South Wales Australia and many students from this area never leave and experience another country or culture. Many students around the world don't have opportunities to experience unique places and appreciate the diversity of people, experiences often required for global citizenship. Our framework uses avatars and virtual world campuses and provides opportunities for ongoing global team-teaching and student-centred collaborative projects. The Pangaea Minds framework collapses the silo structure, students work together as teachers, modelling and supporting students in problem-solving and play.

The United Nations estimates 69 million new teachers are required to achieve universal Primary and Secondary education by 2030. There is a looming crisis: a lack of teachers. The Director-General of UNESCO, Irina Bokova states 'education holds the keys to a more peaceful and more prosperous 21st century it is essential for individual dignity and a motor for sustainable development. Teachers stand at the heart of this vision.' The world needs more educators and innovative approaches to support teachers. Virtual World Technologies and the Pangaea Minds framework brings teachers together on a global scale for professional development and training to improve the breadth and depth of quality teachers. The Director of the Division of Education for Peace and Sustainable Development of UNESCO, Soo-Hyang Choi, points to the specific role of teachers in developing global citizenship, 'they aim to empower learners to engage and assume active roles both locally and globally and to face and resolve global challenges such as peacebuilding or environmental issues teachers have a role to play in this context'. As much of the world continues to have closed borders and student exchange programs and gap years have ceased, virtual world campuses provide an immediate interim solution.

The limitations of online learning systems and webcam tutorials were exposed during lockdowns. Forbes Education author Zak Ringelstein argues that, according to Maslow's Hierarchy of Needs, a child's third most basic need after survival and safety is a sense of belonging. Without a sense of belonging, children are unable to build self-esteem or start on a journey to self-actualization.

Friendships are built in the in-person classroom, at lunch and on the playground and are the building blocks for a critical part of childhood development teacher affection and relationships are what many children come to school for every day. However research on video conference calls demonstrates the difficulty in building connections. Instead of bonding people and giving them energy, participants fail to form real human connections and feel fatigued.

As a teacher with 20 years experience and an e-learning coordinator, I realised our current system (designed over 100 years ago) and these technologies (that are decades old) were failing many of our students during lockdowns. New solutions are required such as new virtual world technologies like Virbela and Frame VR that enable social and spatial presence, fostering a sense of belonging. Pangaea Minds uses these technologies to facilitate a global network of students to only know how to work together. Our framework supports teachers to collaborate across continents and cultures. In addition, these technologies offer affordances for social and spatial presence for communities displaced by bushfires, floods, and the pandemic.

Classrooms are increasingly adapting in the age of Web 4.0 and devices like smartwatches are connecting and sharing data with other items and systems creating smart schools. Our vision extends this connection to include teachers and students around the world. The United Nations reports that even before the pandemic the world was already facing formidable challenges to fulfill the promise of education as a basic human right. An extraordinary number of children, more than 250 million, were out of school. The UN estimates some further 23.8 million additional children and youths will have dropped out or not have had access to school due to the pandemic. In the near future there will also be an increasing number of climate change refugees, asylum seekers, economic and social migrants adding to the list of children with interrupted educations. The Pangaea Minds framework offers Primary and Secondary school students an opportunity to belong to a stable online community within a virtual world campus, a place of familiarity with teachers and students from around the world for support. Join Pangaea Minds and play a part in cultivating a more empathetic generation.

Pangaea Minds has partnered with Los Angeles based Youth Research Vox to facilitate the 2021 United Nations Sustainable Development Goals Competition. Using FrameVR global teams of students will collaborate over 16 weeks and design solutions to real-world complex problems. Rather than compete as a team representing their school, students develop global awareness and global citizenship as they work together across continents and cultures.

Registrations close on the 29th July

https://www.youthresearchvox.org/2021-international-competition

The ACMI Game Lessons Library

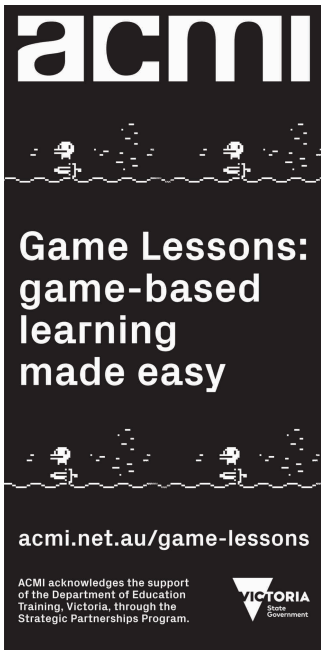
By Vincent Trundle, ACMI

The Game Lessons Library is a highlight of ACMI's teacher and classroom-focused resources. Game Lessons is a program of free lesson plans that help teachers to incorporate videogames effectively into their learning programs. The Game Lessons initiative fosters a cross-curriculum learning community and builds teachers' capacity to create, access and share practical lesson plans.

As we launch the Game Lessons Library in 2021, there is a growing awareness of the potential of videogames to activate learning through creative and collaborative play, problem-solving, critique and design thinking. As a result of COVID-19 lockdowns, many school-age young people expanded their online gaming experience to involve vital social gatherings to make up for the lost in-person contact they were used to with their friends and peers. This has led to a greater recognition of the ability of videogames to make a positive contribution to mental health and social connection and has highlighted the benefits offered by the thoughtful incorporation of videogames into the curriculum.

Videogames are powerful learning tools when embedded within the curriculum. They can develop critical and creative thinking, promote important cross-curricular learning, while building personal, social and ethical capabilities. This rich area of learning connects STEM and Digital Technologies to the Arts, English and the Humanities. ACMI is a leader in videogames and learning and an internationally recognised champion of videogame culture and is committed to supporting teachers in using videogames in their teaching practice.

In 2018 the Victorian Department of Education and Training (DET), through its Strategic Partnership Program (SPP), funded ACMI to develop and deliver Game Lessons - a program to extend effective teaching and learning through using videogames in the classroom. Game Lessons aims to build a dynamic professional learning network of expertise for the collaborative co-creation of practical teaching resources using videogames. As part of this network, teachers create, use and share well-designed lesson plans for impactful and meaningful learning experiences. In parallel, Game Lessons has built on the annual Education in Games Summit and ACMI's industry-focused co-working space ACMI X to draw together industry and teacher expertise and engagement, enabling collegial sharing of practical strategies for effective inclusion of videogames in the classroom.



ACMI Game Lessons

Teachers mingle, share, play and learn at the 2019 Education in Games Summit. Image courtesy Charlie Kinross.

The goals of the Game Lessons project are:

1. Participating teachers will have greater ability to identify attributes of videogames which can stimulate student learning across their school and in different curriculum areas.
2. Participating teachers will better understand how to develop engaging, curriculum-specific learning activities using videogames as a key component.
3. Teachers will be more confident and deliberate in teaching students across curriculum areas using videogames to increase student engagement and learning.
4. Participating teachers will be better able to identify superior videogame lesson plans and their attributes and describe and demonstrate producing them to other teachers
5. Teachers will know how and where to discover and access game-centred lesson plans and to share their own.

The project is delivered through three primary areas of activity:

- An online professional learning community in collaboration with relevant subject associations (e.g. DLTV, Art Education Victoria and the Australian Literacy Educators' Association) to support implementation of videogames within classroom practice.
- A teacher professional learning program, with three sessions annually; two targeting regional participants and one metro session. This program is presented alongside DLTV Digital Technologies Curriculum sessions.
- Teaching and learning resources hosted on the ACMI website and linked to FUSE. These practical and relevant resources are to be searchable by curriculum terms as well as keywords.

In designing and delivering these activities, ACMI educators engage in strong reflective practice, continually observing what is and what is not working using a mix of qualitative and quantitative measures. We also take advantage of new opportunities to better support the outcomes of this project, and to connect with wider programming from ACMI and the games sector.

This has included:

- A full-day Lesson Plan Development Workshop with teachers already using games in the classroom to develop a suite of game-centric lesson plans.
- Programming at ACMI's Education in Games Summit designed to expand the audience for the program and bring in new participants
- Engagement with external games events during Melbourne International Games Week, including, PAX the Penny Arcade Expo

Teachers from varied year levels and subjects at the 2019 Game Lessons PL session at ACMI, Federation Square.

Student playing the international hit Australian independent videogame - The Gardens Between - in ACMI's newly opened The Story of the Moving Image exhibition.

- Connection of teachers with ACMI's Games and Emerging Technology Programming including Behind the Screens, expanding the reach of the program and integrating connections with professional game developers.
- Partnering with the Games for Change Asia Pacific Festival in 2021 to bring attention to other important and evolving areas including using videogames for health and medical outcomes, civil and civics advancement, and the use of augmented and virtual reality for learning.

Untitled Goose Game. Image courtesy of House House.

These new programs connect to broader trends in games and education, both locally and globally, demonstrating that the team at ACMI are frequently ahead of the curve, and well-prepared for the impacts of moving content online when the effects of the COVID-19 pandemic began to impact teachers, students and families.

Game Lessons began as a three-year project and was due to be completed at the end of 2020, but has subsequently been funded for an additional year. This has given us the opportunity to bring together the multiple strands of the project and to deliver the core lesson plan library on ACMI's new website, alongside additional teacher professional learning sessions supported by the online community. It has also provided the time and opportunity to produce online programs showcasing expert teachers and game developers demonstrating development processes, along with deep insights to game-based learning resources, lesson ideas, Esports, career pathways and more.

Teacher from Swan Hill, north-western Victoria, playing videogames at ACMI's touring Code Breakers exhibition, as part of the 2018 Game Lessons PL session.

ACMI recognises the challenges teachers face in getting videogames into their classrooms and is continuing to adapt the program to create multiple diverse entry points, delivery methods and programming to support teachers.

Game lessons is formally launching in Melbourne International Games Week in October 2021 as part of the Games for Change Asia Pacific festival. It is a celebration of the positive power of videogames in education and society. For a preview taster of some of the lesson plans created go to acmi.net.au/game-lessons.

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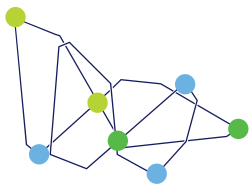

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