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The ultimate sTEm career

Lessons from England

Tales from the classroom
IIATEJ Contributions

This journal welcomes contributions from authors regarding all aspects of Technology Education. The journal aims to educate its readership by providing a balanced view of contemporary issues relating to Technology Education.

Acknowledgements

Special acknowledgements for the contributions made to this issue go to in alphabetical order:

David Barlex
John Barlow
Grant Byrne
Lincoln Gill
Marty Naughton
Astrid Perdriau
Kobe Perdriau
Deborah Trevallion

IIATEJ Contributions

This journal welcomes contributions from authors regarding all aspects of Technology Education. The journal aims to educate its readership by providing a balanced view of contemporary issues relating to Technology Education.

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Welcome to our first IIATEJ edition for 2017. We have had some recent changes to the IIATE structure with the welcoming of a new President. Grant will have his opportunity for a few words later on, but before that, I personally am very pleased to say a few words to our parting President Ruth Thompson.

I don’t know whether it is an Industrial Arts trait of ‘seen it all before’, and I’m certainly not going to ask any past students for comments regarding Ruth’s disposition, but any of you who have worked with Ruth over the years can certainly testify, that she would have to be one of the calmest people I know. Ruth has never been a ‘bragger’, and coupled with her composure is her modesty regarding her amazing achievements as an educator and leader.

When I call Ruth an educator, I am not just referring to her work in a secondary Industrial Arts classroom. As our first ‘Churchill Fellow’ in 1998, Ruth investigated how Technology Education is understood and taught with a focus on the principles of design in four countries around the globe. Using this knowledge Ruth has spent her career disseminating what she knows in providing perspective to both the development, and delivery of curriculum.

As you will find out in David Barlex’s insight into what’s happening in England, it is this global understanding from educated people such as Ruth who have helped to shape the NSW curriculum in a way that has enabled it to be a secure, contemporary, rigorous, and appropriate curriculum over the years.

Ruth has been an exceptional leader, conversant in cutting edge technologies and leads by example. In her role of Head Technology (Industrial Engineering and Information) at Bossley Park HS, her willingness to test out new technologies in the classroom, then share this information, has certainly provided leadership to her staff and the TechEd community through professional learning opportunities at ‘hands on’ events.

Her time on the IIATE presidency throne has been excellent, where she has continued to build on the foundations established by past presidents. During Ruth’s time as president, we have seen the emergence of STEM in Australia, where her knowledge, and understanding of STEM, in particular STEM in a USA context, has enabled her to advise stakeholders in the role of STEM in Australian education.

Even though Ruth has passed on the baton, we know that she will be busy continuing to offer professional learning opportunities to teachers, participating at the IIATE and international conferences, and enjoying her woodwork.

Three cheers for Ruth!

Dave Ellis

“If you can't explain it simply, you don't understand it well enough.”
Albert Einstein
Welcome everyone to 2017. This is the first Institute of Industrial Arts Technology Education Journal of the year, expertly assembled and edited by David Ellis, Lecturer in the School of Education at Southern Cross University. David has been through the process of registering the IIATE Journal with the Australian ISSN Agency at the National Library of Australia. You can now search for the journal using the following information:

Title: Institute of Industrial Arts Technology Education Journal
ISSN: 2205-4421

Taking this as an opportunity to introduce myself to those members who don’t know me, the short version is; I started teaching 17 years ago at Macquarie Fields High School after graduating as part of the final cohort of the B. Ed (TAS) course at the University of Sydney. During this course, John Gibson was the first to introduce us (students) to the IIATE and the Equipment Committee. I was fortunate enough to be appointed to Macquarie Fields HS where David Ralston was the Head Teacher - Technological & Applied Studies. Dave was a member of the Equipment Committee and encouraged me to join the IIATE, which I did. After a year of annoying Dave I was able to attend my first EC meeting. From that time onward I stayed involved in both groups, and others, because I thought that being involved was the best way to be informed of what is happening in the world of Industrial Arts and Technology Education and this would help me be a better teacher.

I would like to say thank you to Ruth Thompson, the immediate past President of the IIATE for her work on continuing to grow and strengthen the Institute as the leading body for sTEm education in NSW. Through her, and the work of the previous Executive, we are in an excellent position to shape the way sTEm and Technology Education is delivered in our schools. The NSW Education Standards Authority (NESA) will soon be releasing the Technology (Mandatory) draft syllabus for public consultation. Every member of the IIATE is an important stakeholder in this process and you should make the time to read the document carefully when it is released and provide your feedback. I also encourage collaborative feedback such as submissions from faculties, schools, or even groups of schools, all led by Industrial Arts, Technology and TAS teachers.

During my time so far as President, I have had a number of opportunities to represent the IIATE, some relating to curriculum matters and others to celebrate the success and achievements of our members and their students.

Due to the exceptional organisational work of Brian Barter, I attended the NSW Science Teachers Association Young Scientist Awards, where a number of students won prizes by submitting work done while studying Technology subjects. The IIATE sponsors the ‘Models and Innovations’ category, so if you are interested in entering the work of some of your students, check it out, let your students know, and enter their work. Your students are implementing scientific and mathematical principles through the Technological skills and Engineered processes you are
teaching them. That is authentic sTEm! If you are interested, examples of 2016 projects and prizes can be found here: http://www.youngscientist.com.au/wp-content/uploads/2016/11/2016-YS-Presentation-Ceremony-Record.pdf

Astrid Perdriau and Peter Thompson received Professional Teachers Council ‘Outstanding Professional Service Awards’ at the end of 2016 in recognition of all the work they have done throughout their respective careers. Both continue to be highly valued and active members of the IIATE.

Most members will be aware of the fantastic Industrial Arts Recollections Project book, “Industrial Arts Teaching: Recollections 1970s 80s and 90s”, produced by Arch Park, Geoff Hogan, Kevin Dodds and John Gibson. If you haven’t read it already I recommend you do. The collection of interviews provides amazing insight into the development of Industrial Arts as a subject area and I think it offers ideas to help us through upcoming curriculum change and other issues currently facing Industrial Arts and Technology education such as teacher training, equipment and our place in sTEm education.

We now have two members who have received the ‘Medal of the Order of Australia’. Arch Park received this honour ‘For service to education, and to industrial arts’ on Australia Day, 2017. This is thoroughly deserved and a read through the Industrial Arts Recollections Project book emphasises how much Arch has contributed to the development of Industrial Arts and Technology education. Arch joins Geoff Hogan, who received his OAM in 2006 – Well done Arch!

The IIATE continues to support initiatives such as the University of Wollongong Awards, the Aeronautical Velocity Challenge and the Wood Show Challenge. The AVC and WSC are organised and run by volunteer members of the IIATE for the benefit of other members. All three programs demonstrate the consistently high quality of work produced by our students. The AVC and WSC might seem like they are completely different programs, but what they share in common is their application of sTEm principles. These programs offer students the opportunity to make something real, something that they enjoy, and that could be the beginning of a lifelong engagement with sTEm that you have introduced them to.

I have begun running weekly sessions for IIATE members on Friday afternoons at Macquarie Fields HS. The focus on Stage 5 Industrial Technology – Timber this term and how the knowledge and skills lead into the Stage 6 course. Those who are attending will make a few projects, look at differentiated programming, assessment strategies, content delivery, resource development, tool and equipment maintenance; and also how it all fits into sTEm education. Everyone should walk away with a fully resourced program and completed project to use as a work sample. Next term the plan is to run sessions for Graphics Technology looking at Architectural Drawing. After that I’m hoping someone else will offer to run sessions on a topic or area they are passionate about. This is something that anyone can do and if you’d like to have a go yourself feel free to contact me to discuss how you can do it. I realise not everyone can make it to my school by 4pm on a Friday afternoon, but I do feel this is something that others can get running in their area and will help develop stronger professional relationships with those nearby.

As I said earlier, your students are implementing scientific and mathematical principles through the Technological skills and Engineered processes you are teaching them; in Technology (Mandatory), Industrial Technology, Design & Technology, Graphics Technology, Engineering
Studies and all of the Technology based subjects that we offer. That is authentic sTEm! We need to be the leaders in this area of education. Let’s start promoting what we do, how we do it and the results we achieve with our students! Let your school senior executive know, get them in your classes and show them what we are doing. We can do this is by showcasing examples in school newsletters so parents and the wider community know what we do, and why the T and E are the most important and relevant areas of sTEm for them and their children’s future. Engage in your professional reading! Stay current with what is happening in the world around us and find ways to bring new content into the workshop to engage the kids. Share with your colleagues, and maybe even get actively involved with your professional association- the Institute of Industrial Arts Technology Education.

We have a great team of people who volunteer their time to provide the best service possible to IIATE members though Hands on Technology weekends, the annual conference, different competitions and other activities; but there is always room for more people to help. Feel free to come along to a meeting or contact me if you’re feeling inspired to do more.

Grant Byrne
Institute of Industrial Arts Technology Education President
grant.byrne@det.nsw.edu.au
Dear Head Teacher / Teacher of Industrial Arts and/or TAS

Should you not have already met us, nor be aware of who we are, we are the Institute of Industrial Arts Technology Education (IIATE), your Professional Teaching Association. We are a ‘not for profit’ organisation run by volunteer teachers, from State, Independent and Catholic schools, such as yourself.

We are your major provider of professional training in the areas of Industrial Arts based subjects including all areas of Industrial Technology, Design and Technology, Engineering, CAD and multimedia. We offer a number of training and information opportunities across the state to enable our members and non members, to be informed and capable of teaching today’s subjects to our students.

Our major event is the annual ‘IIATE Technology Education Conference’ held in October, which we hope that you can attend. This event consists of five events. There is an all day ‘Hands On’ training event on Thursday 19th October, 2017, with the Conference Welcome that night. Friday 20th and Saturday 21st are the main conference days and include breakout workshops along with auditorium sessions. The conference dinner is on Friday night. Guests are most welcome to attend the evening events. Each event is endorsed for accredited hours.

We do offer ‘one-off financial assistance’ for a few teachers in remote and isolated communities, to attend the conference. You just need to apply – see our website on how to do this.

We run other ‘Hands On’ events over weekends throughout the year – endorsed for accredited hours, to give you opportunity to ‘upskill’. The next one is to be held at Killara High School over the weekend of the 1st and 2nd of April. See the website for more information.

Four IIATE meetings are held each year at different locations around the State, all members are welcome to attend. Our last one was on the 11th of February in Swansea, the next one will be in Orange on the 20th of May.

The ‘Wood Show Challenge’ for 2017 is up and running. If you are interested in having your students compete or in hosting a local area competition, please contact Marty Naughton ASAP. The state finals are at the Sydney Timber & Working With Wood Show in July. Information is available on the website.

The ‘Aeronautical Velocity Challenge’ is also underway. Please see the information pack on the website for more information.

The IIATE endeavours to keep the costs for all events to an absolute minimum and subsidises members. Non-members are always welcome to attend every event. Please see the page included titled ‘How to join your Professional Teaching Association’.

Visit http://www.iiate@asn.au for more information

Kind regards,

Grant Byrne

Institute of Industrial Arts Technology Education President
IIATE Membership

RENEWING INDIVIDUAL MEMBER OR FACULTY MEMBERSHIP:

1. Head to IIATE.asn.au – click the LOGIN/REGISTER LINK

2. You will be redirected to our MEMBERS PORTAL

3. Use RENEW link even if your membership requires changes (eg: place of employment or membership type)

4. Follow steps to RENEW and EDIT your membership, an invoice will be emailed with payment instructions.

*Email: Jenny admin@IIATE.asn.au if you are having troubles with your renewal
REGISTERING AS A NEW INDIVIDUAL MEMBER OR FACULTY MEMBERSHIP:

1. Head to IIATE.asn.au – click the LOGIN/REGISTER LINK

2. You will be redirected to our MEMBERS PORTAL

3. Use the JOIN link – you will have the option to select the membership bundle suitable for your faculty.

*Any faculty member can do this process on behalf of the school, you may also enter school admin and finance contact details

4. Enter personal/school details, once the invoice is paid, additional member information is entered and memberships are activated.

*Email: Jenny admin@IIATE.asn.au if you are having troubles with your renewal
Draft Syllabus Consultation

The Technology Inspector for the NSW Education Standards Authority, Mark Tyler has already been emailing you about your input regarding the draft syllabus for Technology Mandatory Years 7-8. The consultation dates are from the 6th of March to the 5th of May, so have a read, and use this opportunity to have your say. Every submission is read and taken into consideration!

There are three ways to contribute

Download the Introduction to the Draft Syllabus and the Draft Syllabus and read it

1. Read the online survey statements then complete the online survey
2. Written Submissions

Please send written submissions for the Science and Technology K–6 draft syllabus and the Technology Mandatory Years 7–8 draft syllabus to:

Alesha Bleakley
Senior Curriculum Officer, Technology Education
NSW Education Standards Authority
GPO Box 5300
Sydney NSW 2001
alesha.bleakley@nesa.nsw.edu.au

3. Attending the consultation meetings at the following dates, times and venues:

<table>
<thead>
<tr>
<th>Date</th>
<th>Science and Technology K-6</th>
<th>Technology Mandatory Years 7-8</th>
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<tbody>
<tr>
<td>16 Mar, 2017</td>
<td>Ballina Island Motor Inn</td>
<td>Tamworth Leagues Club</td>
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<tr>
<td>21 Mar, 2017</td>
<td>Club Macquarie, Newcastle</td>
<td>Club Macquarie, Newcastle</td>
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<td>22 Mar, 2017</td>
<td>Burwood RSL</td>
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<td>Bathurst RSL</td>
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<td>28 Mar, 2017</td>
<td>Hurstville Club Central</td>
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<td>30 Mar, 2017</td>
<td>Campbelltown Catholic Club</td>
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<td>3 April, 2017</td>
<td>Pymble Golf Club</td>
<td>Pymble Golf Club</td>
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<tr>
<td>5 April, 2017</td>
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<td>Parramatta RSL</td>
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Please check the NESA site regarding times and directions.
Design & Technology in England:

Currently we are in difficult times but there is a light at the end of the tunnel?

Dr David Barlex

Peering through the economic lens, curriculum as a part of the educational landscape has increasingly been shaped by the complexities of change and what is happening overseas. In an effort to equip a future workforce, and to ensure Australia is in a favourable position in relation to other countries, documents such as the 2009 Melbourne declaration of educational goals, brandish concepts such as globalisation, technological change, and social and economic prosperity, to direct policy and adjust curriculum.

This is not to say it is a bad thing, as teachers we value a ‘backwards design approach’ in setting goals, then working out how we are going to get there. In recent times we have witnessed the noticeable changes to curriculum as concepts such as preferred futures, systems thinking and computational thinking emerge in contemporary curriculum documentation to address the desired educational goals.

How this applies to us is not only the changes to teacher knowledge syllabus documents as the curriculum evolves, but it is the shift in the focus of ‘what’ and ‘how’ we teach. Two strong examples of this is the relatively recent emergence of STEM in Australian classrooms, and the distinction being made between design and digital technologies. It is not the point of this article to get bogged down in these ‘political’ discussions, the point being made, is that the outcomes that appear in our classrooms are largely dependent on our engagement in these changes.

To provide us with some insights on change, I have asked if David Barlex could inform us about changes that have been happening in England. As you may know, England is renowned for its excellent work in Design and Technology. David is a well-known international expert in Design and Technology who has taught in schools and at universities in teacher education. He is actively involved in teacher development and been at the forefront of Design and Technology curriculum matters. David, would you mind giving us some perspective on what is happening and your analysis of why and how can England and D&T move forward?
In England design & technology is in the doldrums. There has been a serious and continuing decline in the uptake of General Certificate of Secondary Education (GCSE) design & technology since the subject was introduced into the National Curriculum (Figure 2). At that time, some 95% of young people studied the subject to the age of 16+. 26 years later this has fallen to about 28% and, with the removal of food from design & technology specifications, it is predicted to fall much further.

One of the reasons for this situation is the unintended consequences of government accountability measures. In October 2013 the Government introduced four new accountability measures which schools are required to publish on their websites so that parents could see how well a school was performing, I will briefly describe these four measures below:

- The first was Progress across a suite of 8 subjects, (known as Progress 8). Similar to the tracking of student progress in the Australian NAPLAN tests, this was devised to show whether pupils performed better than expected at the end of Key stage 4 considering their starting point. Key stage 2 results (for pupils aged 11 years as they are about to leave primary school) are used to predict each pupil’s likely grades across 8 subjects at the end of Key stage 4.

- The second was Attainment across 8 subjects, (known as Attainment 8). This was devised to show the school’s average grade across the same suite of 8 subjects as the progress measure. This was expected to show achievement across a broad curriculum in a clear way.

- The third was the percentage of pupils achieving a C grade or better in English and mathematics. This was devised to show whether pupils achieved a good level in the most important subjects.

- The fourth was the English Baccalaureate (EBacc) which is not a qualification in its own right. It has been established to provide information to parents, and others, about the achievements of pupils in a core set of academic subjects which are shown to enhance the chances of progressing on to further study. To meet EBacc criteria, a pupil must have obtained a grade A* to C in English, maths, two sciences, history or geography (referred to as humanities), and an ancient or modern foreign language. This accounts for

![Graph of numbers of students taking GCSE design & technology](Figure 2 Graph Courtesy of Alison Hardy (2015) and JCQ.)
five of the subjects making up the suite of subjects in Progress 8 and Attainment 8, leaving three slots that can be taken up by further qualifications from the range of EBacc subjects, or any other high value arts, academic, or vocational qualification. English Literature counts in this group of subjects.

The good news for design & technology is that it counts within the high value academic qualifications. The bad news for design & technology is that the way this plays out in the choices that schools offer pupils aged 14 is that the subject often finds itself in a single option column competing with subjects such as art, art and design, music, and drama.

Nick Gibb, the Minister for Schools, has argued that the structure of these accountability measures are in place to help the most disadvantaged young people:

“If we are to deliver a fairer, more socially mobile society, we must secure the highest standards of academic achievement for all young people, and especially those from the least advantaged background.”

This argument is not confined to those on the right in politics. Diane Abbott a prominent left wing MP offers an almost identical argument

“Precisely if someone is the first in their family to stay on past school leaving age, precisely if someone’s family does not [have] social capital, and precisely if someone does not have parents who can put in a word for them in a difficult job market, they need the assurance of rigorous qualifications and, if at all possible, core academic qualifications.”

So it is unlikely that a change of government would lead to a change in policy, and the unintended consequence of this attempt to achieve social justice is that it is likely to limit even further the number of young people that study design & technology to the age of 16 years.

It would be unfair to blame the decline in numbers solely on these accountability measures. They may have exacerbated the trend but, other subjects have not suffered such a decline. In 2015 Religious Education had almost 300,000 entries, the highest level since 2002, art & design subjects were up by 1.7% to almost 200,000 and music was up by 2.2% to almost 50,000. To put it bluntly as a head of department recently said to me recently, “D&T really does need to stop whingeing and up it’s game if it is to reverse this trend and increase its popularity”.

So a key question must be

“How do we up our game?”

One way must be to respond positively and effectively to the curriculum changes the government has introduced. There is a new National Curriculum Programme of Study for pupils aged 5 – 14 and a new single title Design & Technology General Certificate of Secondary Education (GCSE) has been introduced to be taught from September 2017.
The latter is particularly challenging as it treats design & technology as a single subject expecting all pupils to be able to use a range of different types of material, a wide range of functional components involving programmable electronics, and designing from a context where they explore and identify their own design brief. This is a far cry from the single material focus area that the GCSE’s currently taught, and at Minister’s insistence does not include food as a material. This, to my mind, is a definite improvement as it allows the subject to be taught in a single coherent and progressive course across five years in the secondary school. This eliminates the harmful and divisive internal competition between the individual areas that took place in teaching pupils aged 11–14. In this situation the main aim of the teaching was to ensure that enough pupils opted to take the single material courses. Responding effectively will require teachers to work much more collaboratively and modernise with the introduction of digital technologies for both designing and making, plus the inclusion of embedded intelligence in the items their pupils produce.

**What does the future hold for the subject?** One way to explore this is through scenario building using so called critical uncertainties. Here are four possible scenarios by using as one uncertainty the extent to which D&T modernises and as the other uncertainty the extent to which design & technology is seen as a vocational option for the few or as general education for all. This is shown diagrammatically in Figure 3, above.

![Figure 3 Possible scenarios for the future of design and technology](image)
If we are to re-build the subject so that it meets the vision and expectation of its original conception, and regains status as a worthwhile subject, all those involved in teaching and supporting the subject will need to work together so that for the majority of teachers in the majority of schools operate in the top right hand corner, scenario 2 of Figure 1. That is the light at the end of the tunnel!

Thank you David for providing a valuable insight into D&Ts recent past and hopefully brighter future. For Australian technology teachers who have experienced curriculum change by either developing programs for the Australian Curriculum, or been involved in the development of new curriculum for NSW. What can we learn from this?

We teach an area of education that is particularly sensitive to technological evolution. The trailblazers of the past have provided us with an excellent foundation of subject matter that we can creatively build upon, but as we have experienced recently, influential stakeholders who are either ‘outsiders’ or unfamiliar with what we do in technology education think that concepts such as ‘hands-on’ activities and maker spaces are an new and innovative concept. Some even think that a STEM pedagogy is the only opportunity for the development of learning experiences that address 21st century needs. Not to take a negative view, but in some ways as a collective learning area, we need to overcome our modesty and promote what we do, and provide explicit examples of what we can do! A take away from what David has provided us about D&T in England is that for some, we need a ‘shake-up’ and embrace the opportunity to design exciting and contemporary technology experiences that embrace digital technologies with a view of it being an education for all with higher-order thinking, and not just the development of skills for a future vocation.

It is fortunate that we do have trailblazers out there who are embracing new technologies, taking the sTEm reigns, shaking it up, making mistakes and kicking goals. Most importantly is it not about them, but their students, who are having fun and attained a high quality education that will enable them to participate in the future.
ATTENTION: TAS/INDUSTRIAL ARTS/COMPUTING FACULTIES

STAGE 5 MULTIMEDIA
ART METAL WORK: JEWELLERY
LEATHERWORK + 3D PRINTER
BYOD TECHNOLOGY MANDATORY
ILLUSTRATOR + LASER CUTTER
SKATEBOARD CONSTRUCTION
BLENDER 3D - INTRODUCTION
WATERBOTTLE ROCKETS
SKETCH UP
ONSHAPE
ARDUINO STAGE 4
ARDUINO STAGE 5
FUSION 360
E-TEXTILES

HANDS ON TECHNOLOGY 2017

WHEN? SATURDAY 1ST APRIL 2017 - 8:30 REGISTRATION - 9AM - 4PM
SUNDAY 2ND APRIL 2017 - 8:30 REGISTRATION - 9AM - 1PM

WHERE? KILLARA HIGH SCHOOL
Koola Ave, Killara

GAIN VALUABLE "HANDS ON" PROFESSIONAL DEVELOPMENT
TALK TO TEACHERS FROM ALL AROUND THE STATE
UP-SKILL YOURSELF

REGISTRATION AND WORKSHOP DETAILS AT:
http://iiate.asn.au/events/events-calendar/2017-hot-killara/

WANT MORE INFORMATION? CONTACT: pd@iiate.asn.au

IIATE through the Professional Teachers' Council NSW- Board of Studies, Teaching and Educational Standards (BOSTES) as the endorsed provider of QTC Registered professional development for the maintenance of accreditation at Proficient, Highly Accomplished, and Lead levels.
Scope of Endorsement:
- All Standards of the Australian Professional Standards for Teachers at the level of Proficient and Highly Accomplished and Lead.

Completing the Hands on Technology Junior workshop 1 & 2 April 2017 will contribute 11 hours of QTC Registered PDU addressing 2.6.2; 3.1.2; 3.4.2; 4.4.2; 4.5.2; 6.2.2; 6.3.2; 7.4.2 from the Australian Professional Standards for Teachers towards maintaining Proficient Teacher Accreditation in NSW.
The ultimate sTEm career: Plugging what we do!

Introduction
This article is based on the premise that as a community of educators, we have been enthusiastic and active in pushing STEM related careers due to the skills and knowledge that our students exit our courses with, and what we value in preparing students for the future. According to a North American based report, the number of students interested in studying STEM at Colleges in the USA is on the rise, indicating that the efforts of teachers in primary and secondary education is starting to gain some traction! (Higher Education Research Institute, 2010). An Australian piece of research supports this turn around, suggesting that contrary to the 2012 Office of the Chief Scientist report that the student participating rates in STEM are falling, for some time the rates of decline have plateaued, and as an example, in our own state of Victoria, STEM participation rates have been on the rise (Panizzon, et al. 2015).

Taking these two pieces of research at face value, this good news could indicate that our collective efforts are starting to have an effect. At a state level, increasing numbers of schools offering Stage 5 Engineering and iSTEM courses may also be a positive sign if these classes are in addition to our regular Stage 5 offerings. Taking the much deserved pat on the back when it comes, it is certainly a positive sign that NSW TechEd teachers are enthusiastic and are willing to try new things.

Trying new things, Illawarra Mercury story on the Aeronautical Velocity Challenge (13/6/16). Courtesy of Adam McLean
Taking the increasing number of STEM participation rates as a good sign, an area that needs work is the encouragement of students to consider taking up technology teaching as a career. Currently, the number of students enrolling in Technology Education is a concern, and looking ahead does require our collective attention to shape the future. It is good that we have been pushing other STEM careers, but we also need to consider what we do as also a worthwhile and rewarding career for those students who we may identify as potential teachers in technology education.

The current situation

Research into the teaching workforce has provided us with insight in the current, or at least contemporary staffing situation. What is important for us to know is that the demands for teaching staff is not homogenous and varies according to factors such as areas of specialisation and location. As an example, a report on the teaching workforce by Paul Weldon in March of 2015 stated that in most states, there is at present a “considerable, oversupply of generalist primary teachers” (Weldon, 2015 p. 1), but that is certainly predicted to change in the near future. One statistic quoted in News.com.au said that with a rise in school age populations there will need to be about 1761 extra primary school classes created each year until the year 2020 (Burgess, November 6, 2015). What can be learned from this is that it is a safe assumption that these primary school students will enrol in years 7 and 8 in high schools across the nation starting from next year.

Weldon’s report also states what we already know in specialist areas of secondary education being that “regional and remote areas tend to experience greater difficulty attracting and retaining teachers at all levels than do their metropolitan counterparts.” (Weldon, 2015 p.1). Anyone who follows the ESNET will agree with this statement, as we often see our regional and remote colleagues putting the word out to fill staff vacancies.

Before writing further, it would be appropriate to acknowledge the disclaimer that this number only reflects DET schools who have registered and are publishing vacancies, and that it is completely possible that we have could have had a ‘man’s look’ at the figures. At a surface level, with 13 technology teacher vacancies currently listed on the ‘JobFeed’ of the teach.NSW website (as of the 28th of February) one could argue that there is no ‘real’ shortage of Technology teachers. However taking the projected increases in student population is over a short period of time (3 years) and it takes 4 years (minimum) for a teacher to graduate from university, any shortage is not too far away.

Increase in student population = increase in teacher supply demands
According to ABS data regarding gender, the percentage of males in the secondary teaching workforce has been steadily dropping to 42% in 2011. Whilst this figure initially sounds good with the teaching workforce transitioning towards gender parity, the older baby-boomers that are (happily) marching towards retirement are made up of a majority of male teachers.

To elaborate on how this impacts on technology education, there are a number of subject areas under the ‘Industrial Arts’ label of subjects where male teachers have traditionally dominated these subjects. By the way, Industrial arts subjects are not the only areas where there has been a domination of male teachers; physics, mathematics and IT to name a few, are also dominated by the male of the species. Even though it is good that there are more female secondary teachers, to spell the situation out a different way, if this large percentage of male baby boomers (who teach our technology education subjects) enter retirement, and neither males nor females are finding technology teaching (industrial arts in this instance) as an attractive profession, then this is an influential factor that could lead to a teacher shortage.

Technology teacher retirement = increase in teacher supply demands
For a long time now we have talked the talk and begun to walk the walk, promoting a message that through alternate pedagogies such as a creative programming, STEM, and single sex classes to name a few, that we need to be encouraging the uptake of girls into our subject areas. In the context of this article, the encouragement of girls in our subjects is not only for the purposes of encouraging girls to enter into STEM fields and choose STEM careers because they are good at it, but to encourage girls into our subjects, because they may like it and may consider technology teaching as a career option.

Unfortunately the challenge does not stop there. If teachers are successful in encouraging both girls and boys to enrol in technology teacher education, an increase in the number of number of technology teachers graduating from Initial teacher Education (ITE) is not the end to a technology teacher shortage. According to research by the Victorian Tertiary admissions Centre (VTAC) and Mayer et al. (2014), student attrition rates from ITE programs is considerably high after the first year (approx. 23%), with approximately another 20% of those who graduate from ITE are unavailable for employment (Mayer, 2014). A statistic reported by AITSL supported this, and has stated that “just under half of graduating teachers are employed full-time in schools in the year after completion” (AITSL, 2016 p.6).

Once teachers have graduated, and are employed as technology teachers in school across the nation, the potential for teacher shortages in technology does not stop there. Retention of qualified teachers in teaching is a concern with literature suggesting that the high workload, and a lack of support and recognition as reasons for teachers to leave the profession early in their career (Buchanan 2010) (Gallant & Riley 2014) (Howes & Goodman-Delahunty 2015; Mason & Poyatos Matas 2015; Mayer et al, 2014). Though not producing graduates in technology education it is still worth a brief mention, alternate staffing initiatives such as the controversial ‘Teach for Australia’ (TFA) program produce graduates teachers after a 13 week intensive program and a two week practicum (TFA, 2017). Quality and politics aside, even though the program places teachers in classrooms earlier, according to the NSW Teachers Federation, “the dropout is high, with 50 per cent of its teachers leaving the profession within three years”
(NSWTF, 2016). Considering this, the TFA strategy does not help the current technology teaching workforce, nor does it encourage students into participating in our subject offerings.

To support that these notions of teacher shortages are not fantasy, teacher employment authorities such as the NSW Department of Education have initiated policies to incentivise enrolment and completion of education and re-training programs with an emphasis of attracting teachers to teach in rural NSW. Examples of some of the incentives include rental subsidies (up to 90%), and an increase in transfer points (up to eight points). In some cases there is also a ‘retention benefit’ ($5000) following a period of qualifying service (NSW DoE 2015). In terms of technology education specific strategies, the Sponsored Training Education Program (STEP) has recognised a shortage of teachers who a ‘equipped’ to teach Engineering studies, and as a result have provided sponsorship opportunities for teachers who wish to retrain (NSW DoE, 2017).

**Technology teacher training in NSW: our info**

The impetus for the writing of this article was the a noticeable decrease in the initial enrolment numbers of students entering the ACU and SCU technology education programs by two lecturers in these programs, John Barlow from ACU and Dave Ellis from SCU.

In a casual email conversation between the two, David had stated that at that stage, SCU first year enrolments in Technology Education was down in February of this year. John had responded that ACU was also down in its first year enrolments. This begged the question whether this was a trend in Technology Education in NSW, or just a coincidence? Given what we have just learned about retention rates for early career teachers, and does the lack of students enrolling in technology education ITE programs contribute to the shortages of Technology teachers in NSW?

To elaborate on our situation here in NSW, Table 1. provides a quick view of the numbers first year students enrolled in each of the technology ITE programs in NSW. For your information, if the maths aren’t adding up, all figures have been rounded up to whole numbers. Whilst these numbers may initially appear ‘healthy’ after making assumptions that all of these students will complete their ITE, not all of these graduates will be able to teach ‘industrial arts’ subjects or will be working as teachers. To provide some perspective by attempting to predict the number of teachers still working as technology teachers after 3 years post ITE, the following assumptions have been made:

- **There is an assumed parity between technology teachers who can teach industrial arts and Home economics technology education subjects. As a result the total number of first year students enrolled in these courses will be divided in half (0.5).**

- **Using the research data from VTAC and Mayer et al. (2014), there will be an assumptions applied that 23% of the total number of first year students will withdraw from the program (0.23n).**

- **Finally using the research data from Mayer et al. (2014), an assumption will be made that 20% of ITE graduates unavailable for employment as they partake in other employment or gap year activities (0.2n).**

- **The final assumption to be applied is statement that there is a 50% attrition of teachers who leave the profession after 3 years (y=x/2) (NSWTF, 2016).**
Looking at the figures generated from the simple equations in Table 1, and based on the assumptions described above, we can see that the numbers of Industrial Tech trained teachers for this cohort starting work in 2021 in NSW schools is concerning. And, in 2024, the number of these teachers still teaching in schools has halved again to approximately 37 teachers spread across schools in all systems.

<table>
<thead>
<tr>
<th>Initial Teacher Education (ITE) providers in NSW that produce Technology Education graduates</th>
<th>Number of First year enrolments in to the technology education teacher program</th>
<th>Number of teachers graduating, then employed after applying ITE and post-ITE attrition rates</th>
<th>Number of qualified teachers still in the job after 3 years based on NSWTF data</th>
</tr>
</thead>
<tbody>
<tr>
<td>Formula</td>
<td>( n )</td>
<td>( x = 0.5(n - 0.23n + 0.2n) )</td>
<td>( y = x/2 )</td>
</tr>
<tr>
<td>ACU</td>
<td>56</td>
<td>16</td>
<td>8</td>
</tr>
<tr>
<td>Southern Cross University</td>
<td>69</td>
<td>20</td>
<td>10</td>
</tr>
<tr>
<td>Charles Sturt University</td>
<td>64</td>
<td>18</td>
<td>9</td>
</tr>
<tr>
<td>University of Newcastle Australia</td>
<td>68</td>
<td>19</td>
<td>10</td>
</tr>
<tr>
<td>TOTAL number</td>
<td>257</td>
<td>73</td>
<td>37</td>
</tr>
</tbody>
</table>

Table 1. 2017 TechEd enrolment numbers in NSW and projected numbers

**A way forward**

The numbers in do not paint a pretty picture, however looking at the glass half full, there are a number of strategies that we could consider to rectify the situation and I’m sure that a more collaborative approach could suggest plenty more! As TechEd teachers, we are all excellent problem-solvers, and aren’t afraid of taking on a challenge. To make a start in the right direction, a few potential strategies could be implemented to increase our numbers. These will be briefly discussed below:
Strategy one: Plugging what we do! Every year our Stage 6 teachers worry, sweat, bleed, lie awake, cry, laugh and rejoice over the completion of final year practical projects. As you all know, the realisation of that final ‘capstone’ project to evidence the skills, knowledge and understanding that the student achieved is a powerful relationship building opportunity. A quick example of this bond is supported in this edition’s story on Dhani’s yr12 Major Project, under the guidance of Marty Naughton. The bond that is developed between the teacher and student is a special one that students and their teachers tend to develop as they take that journey together. Every year, exhibitions in schools around the state never fail to amaze us with what these students can achieve over time. The point being, that following this Yr12 major project journey, these students exit senior school studies with an understanding of project management, and highly specific knowledge and skills. Let’s not let them walk away without encouraging them to take up a very rewarding career.

Secondly our TechEd community needs to take a serious look at how we market ourselves. Let’s reframe it with a question: How often do you need to explain what you teach? How many times have you said that you are a Technology teacher to be then thought of as a Computing teacher? Not that there is anything wrong with that, as many of us teach IPT or SDD, but does this capture the breadth of our learning area? No.

We need to be aware that subjects such as IPT and SDD are NSW constructs, and don’t really mean much to people who are aren’t keeping up-to-date with NSW curriculum. Globally, our area of education is classified as Technology Education, however in some parts of the world we are labelled as Design and Technology teachers, and even the acronym STEM is used by some to classify ‘what we teach’. So what is the solution? Revisiting the question, we need to have some
collaborative conversations about who we are and market ourselves to the wider community beyond education. The use of ‘project exhibitions’ are a great way of promoting our area to the wider community and the use of social media is also a great way to connect our learning area and our students’ work with the community.

Finally, what cannot be ignored is the attrition rates from university ITE programs and post-graduation in the first three years of teaching. The 23% attrition rate of first year university students is a huge percentage that the universities need to address in unpicking why pre-service teachers ‘drop out’, and how this can be mitigated? Aside from the first year university attrition rate, research suggests that there is a link between the pedagogical preparation that pre-service teachers receive whilst at university and graduate teacher attrition. This suggests that ITE providers need to ensure that there is adequate opportunity for students to learn about pedagogy, observe teaching (pedagogy in practice) and receive feedback on their own teaching experience during practicum (Ingersoll, R., Merrill, L., & May, H. 2014).

To complement university efforts once students have graduated, mentoring beginning teachers is often touted as one way we can support teachers when they need it most. We know that mentoring is not a new concept, and has been a recognised practice in NSW for some time, however it is arguable that the accountability aspects tied to teacher probationary periods, and teacher registration may have slightly shifted the focus of new TechEd teachers as they work towards proficiency classification (Kemmis, et al. 2014). This is possibly where the TechEd faculty can assist. A faculty working together as a safety net could potentially assist new teachers in the tough first few years of their career.

References


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Final Report.

http://dx.doi.org/10.14221/ajte.2015v40n11.3


Recognition for outstanding work

Congratulations to our own association Vice President and HT STEM at Canobolas Rural Technology High, Mr Matt Scott.

Matt is a recipient of the 2016 Premier’s Copyright Agency Creativity and Innovation Scholarship. Valued at $15,000, it will be used to travel to the USA to investigate best practice how STEM and project based learning is developed, resourced and taught with a focus on a regional setting.

When Matt is not getting his face in the local paper, or Government websites, he is the HT STEM at the Canobolas Rural Technology High School (CRTHS). His school is one of seven STEM action schools across the state, and the only one in rural NSW. This situation presents some unique challenges to Matt, and his STEM team, and it is through the problem-solving and innovative approaches that CRTHS has implemented that can lead future pedagogical practices for schools in rural areas.

Whilst cruising the highways of the USA, Matt intends on presenting at the ITEEA’s 79th annual conference in on the 16-18th of March this year in Dallas, Texas. The IIATE has a kinship with the ITEEA through the attendance and networking of fellow IIATE members such as Ruth & Peter Thompson, Stephen Clayton, and Alesha Bleakley to name a few. If you are ever in the USA, your attendance the ITEEA conference is certainly one not to be missed.
HANDS ON TECHNOLOGY

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ENDORSED “HANDS ON” PROFESSIONAL DEVELOPMENT
Looking forward to engagement with technology creatively

Talking to pre-service teachers enables our readers to learn a little about the TechEd teachers of the future. In this article we catch-up with Peter Stephens from ACU.

Tell us a bit about yourself Peter:

My name is Peter Stephens, I’m from Manly on Sydney’s Northern beaches, and I am currently undertaking a Bachelor of Teaching/ Bachelor of Arts (Technology) at the Australian Catholic University at Strathfield, where I am majoring in timber and engineering, and minoring in computing studies. I have a passion for teaching and technology education as well as a strong interest in woodworking, 3D printing, computer-aided design (CAD), innovation, and all things digital.

I was first inspired to become a teacher and developed my interest in technology whilst attending my local high school, Balgowlah Boys Campus. It was there I had my first teaching experience, where I developed and ran a student led Anti-Bullying program for year 7 students. The school was exceptional in both supporting my interests, and allowing me the freedom to develop and run the program, that in year 12 when I was school captain at the school, I was awarded the Manly Young Citizen of the Year award for my efforts. I currently work as a Student Learning Support Officer at a local high school with students with disabilities and learning difficulties, as well as in the hospitality industry with the Accor Hotels group. In between my university studies and work I also volunteer with my local council as a member of the Sister Cities Committee, where I assist, organise and chaperone educational exchanges for high school students from the Northern Beaches area to and from Japan. I have also recently become a volunteer advocate for StreetWork to help and support at risk teenagers.

Prior to commencing my Technology teacher education course with ACU, I worked as a Student Learning Support Officer (SLSO) at Killarney Heights High School with students with special needs, and learning difficulties. This role has provided me with a great deal of knowledge and insight into working with students with special needs such as cerebral palsy, muscular dystrophy, autism, and ADHD in the classroom, as well as the types of adjustments teachers can use to help support students achieve success. Although I am specialising in timber and engineering at university, I also have a background in hospitality having worked in a variety of roles within hotels in areas such as front office, conference and events, food and beverage, and customer service. Prior to undertaking my studies, I have also been a member of the Sister Cities committee at Manly Council where I have been lucky to assist organise and chaperone five student exchanges consisting of 25 students aged 14-17 studying Japanese at high school to Odawara in Japan.
It is always good practice to reflect on what ‘effective teaching’ is. Once we can recognise it, we can adjust our pedagogy to replicate it. Peter over the years as a product of the education system, you have observed effective teaching, and now have an idea of what effective teaching is. In your opinion, what makes an effective teacher?

Teaching is a complex multifaceted job, and being an effective teacher in today’s schools requires much more than just a knowledge of the teaching content. To me, effective teachers:

- Believe that all their students are capable of success and aim to motivate and engage all of their students in learning regardless of their ability or background.
- Understand, acknowledge and accommodate the individual differences of students in their classes, and use a range of pedagogical strategies that suit the needs of their students, and ensure all students are challenged and engaged in learning.
- Have high realistic expectations of their students and provide support and feedback to help their students achieve those expectations.
- Help students see the significance of the work they are doing so they can make meaning of, and connections between, what they are learning, and the outside world.
- Provide students with a safe and supportive quality learning environment that encourages learning and the exploration of new ideas.
- Get to know their students and take a genuine interest in their lives.
- Work collaboratively with others and regularly reflect on their own practices to refine their craft and improve student learning.

How have your studies at the Australian Catholic University helped prepare you for work in the secondary school technology classroom?

The Australian Catholic University and their teaching staff has been fantastic in providing me and my fellow peers with the knowledge and resources to be effective 21st century teachers. Their fully equipped science, food, textile, timber, and metal technology labs also provided me with the necessary skills and confidence to effectively teach the practical requirements of the technology curriculum. The inclusion of a twelve-week industry internship in our area of specialisation as part of our course was also beneficial in helping me prepare for teaching as it provided me with the opportunity to acquire first-hand knowledge about industry from industry professionals, and develop specialist skills.

What are looking forward to the most when you begin your career as a technology teacher?

Whilst I can’t wait to just get into the workshop and teach students about all the creative projects we get to make in Technology, I would say I am most looking forward to seeing students using and engaging with technology creatively to explore new and interesting ideas, and develop innovative solutions to the problems they are presented with.

Peter, this is your opportunity to promote yourself to any potential employers. What skills, knowledge, and characteristics do you possess that would make you a great asset to any school?

I am passionate about education and as a teacher want to support, motivate and engage students in learning, and ensure that all students are provided with an equal opportunity to achieve their best whilst at school. I have lots of experience in working with students with special needs and as a result have acquired in-depth knowledge of support strategies and adjustments teachers can use to help students with special needs achieve success. I have an in-depth knowledge and understanding of a range of pedagogical strategies and their role in supporting and guiding student learning. I am skilled, knowledgeable, and enthusiastic about woodworking, engineering, and design, and also have a strong interest in CAD design and 3D printing, and would be eager to educate and explore 3D printing with students in the school. I also have an interest in innovation and innovative solutions to real world
problems, therefore would be excited to develop student design projects that engage students with real and relevant issues. I also have had lots of experience in school leadership roles having previously been school captain and chairperson of the SRC at my high school, therefore would be excited to be involved and help run school leadership programs such as the student representative council. I am also always open to new ideas and actively seek out feedback on how I could improve student learning and my practices as a teacher. And finally, I love to have fun. I believe that learning should be fun, and therefore strive to develop lessons that are fun for the students, and get them excited and motivated about learning.

*Finally, given the opportunity to play around in your workshop, what would we find you doing?*

Given the opportunity, I would say that you would probably find me exploring and testing new and interesting ways of working and designing with timber. I love designing and building projects that incorporate new skills such as timber bending and allow me to expand my current skill set as a teacher so I can pass them on to my future students.

**Two Projects designed and constructed by Peter as part of his teacher education course at ACU:**

1. Tasmanian Oak indoor bicycle storage system that incorporates timber bending techniques:

2. Tasmanian Oak coffee table

*Thanks for your time Peter, it has been great learning a little more about you. Good luck with your remaining studies.*
Attention teachers,

As some of you will already know, I have taken over the running of ‘The Wood Show Challenge’, from Alesha Bleakly, who has stepped aside as she has moved onto other things. Thank you Alesha for all of the work that you have done, and those before you.

‘The Wood Show Challenge’ is a long running initiative by the IIATE, for students to compete in and showcase their expertise in the field of woodworking to the general public, in a competition held at the annual ‘Sydney Timber and Working With Wood Show’ (STWWWS) at Homebush each year.

This is and has always been a state-wide initiative run by IIATE. BUT unfortunately, the take up rate from many regional areas has not been the best.

Being a regional teacher myself, I am very aware of the range of issues for regional schools to be fully involved in this initiative and fully understand why you may not have been in the past.

**So welcome one and all to The New Wood Show Challenge.**

The challenge will stay exactly the same for schools that have competed in this challenge in the past. That is, we need schools to express an interest in competing, we need people who are prepared to host a challenge in their school or local area venue, we need area coordinators to oversee the process.

Once that is set, heats are run in your local area to find an area/regional winner. These area/regional winners then compete in the finals at the STWWWS in Homebush from the 23rd – 25th June 2017.

You decide which date you want to have your heats and the venue, but all heats must to be completed by June 10th 2017, for the winners to be included in the Grand final rounds at the STWWWS.

**The key change** is to give all schools, but especially regional schools, the chance to hold their challenge heats in a public space with a public audience in attendance, to give a similar feel to the STWWWS challenge. This has been trialed at the Murwillumbah Agricultural Show at the end of last year, and in Glen Innes last month where it worked very well. The audience response is amazing and the support of local business was outstanding.
So what do you need to do?

If you have been involved in the past and wish to be involved again, please contact me ASAP. I need your help. (PLEASE put Wood Challenge as email Subject when you contact me)

If you are in a regional area, please contact me and let’s see what we can do to get you and your students involved. I will give you as much help as you need to get the challenge up and running. I will even come and help you run the challenge. I can also run an ‘Upskill’ teacher training workshop at a school in your region on that same weekend.

In the meantime, get your IIATE membership paid and I will have further details for you very soon.

Thanks

Marty Naughton

IIATE Wood Challenge Coordinator

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Same, same but different: A brief look at the design process

As a teacher educator, one concept that does confuse higher education students from time to time is the concept of the design process. Some students think that there is only one process, others are confused by the appearance of models. To add to the confusion, some models explicitly state numerous steps, and one extreme is Archer’s 229 step “systematic method for designers” compared to the models that only consist of a few broad stages such as the 4Ds (Discover, Design, Develop, Deploy). Some models are circular, others appear linear such as Herbert Simon’s model, and so on. This confusion as well as the development of new curriculum has prompted this brief article touching on the design process and the use of language. This article is not an attempt to theorise the differences in the identified models, but to briefly describe them, highlighting some features and provide a take home message to us as teachers who teach design practices.

Those of us who have been around the block a couple of times would know that when we refer to the design process we really mean we are referring to ‘a’ design process methodology, however children (as well as pre-service teachers) may not be aware of this, and fail to understand the different use of language to label certain steps/processes or stages. To highlight some of this confusion, often in times of curriculum change new language is incorporated into educational documentation, as we have witnessed this recently with the language used in the development of a National Curriculum.

![Diagram showing different thinking types: Systems thinking, Creative thinking, Critical thinking, Computational thinking.]

**Figure 1** Applying Australian Curriculum language to a design process.
As the Australian Curriculum permeates into State and Territory Curricula, we are discovering that these terms may not be ‘new’ and may already have existing deep-seated roots in our learning area.

For people outside of education, these terms have no real meaning and they could be categorised as ‘eduspeak’, however what they do represent are types of thinking that good teaching in our area has already, and continues to encourage. What is useful though about this explicit use of language and categorisation of terms is that it can be a safety net for all teachers to plan for and develop.

One example is the design activities evident in as we overlay the types of thinking with some common design activities (Figure 1). Figure 1 is not an attempt to create a new design process model or belittle the educational value or rigor associated with these types of thinking, as this is not their intended use, nor the intended application of these terms. This is just an example that demonstrates how the everyday classroom activities that we - as technology teachers- can couple, and find relevance with the latest ‘eduspeak’.

In the Australian Curriculum subjects; Design & Technologies and Digital Technologies, the design processes are categorised according to five broader activities that include Investigating, Generating, Producing, Evaluating and Collaborating & Managing (ACARA, 2014 p.66) and a sixth category of Collecting, managing and analysing data for the Digital Technologies subject. At face value these activities could be repackaged and presented as steps of a design methodology or an innovation process, and based on the level of deconstruction, further specific design activities could increase the number of these steps. This could be how Archer ended up with his 229 steps!

Looking at the language from the current state context, the NSW Board of Studies 2003 document; Technology (Mandatory) correctly specifies the application of ‘a’ design process and also provides some direction in the specific design process activities including, establishing a criteria for success, researching, and experimenting and testing ideas to name a few (NSW Board of Studies, 2003 p. 20). Being an older document, it does not contain any of the latest educational ‘buzz’ words found in the Australian Curriculum, however the activities that are being directed by the 2003 still are relevant and relate to the contemporary terms mentioned in Figure 1.

The much anticipated update to the NSW Technology (Mandatory) syllabus is over as NESA just released for consultation is the Draft Syllabus document (BTW- closes 5th of May, so please add your submission). This iteration of the syllabus does incorporate the new language to support new focuses and contemporary ways of thinking.

Where this may apply to us a teachers who guide students through design processes is not the use or change in language (as the good teachers will recognise what quality teaching and learning is), what is important is the acceptance of this change, in an effort to recognise it, and understand the context for it in an effort to maximise student learning (phew what a sentence!). To support this view, and to use it as an example, this article will briefly look at the initially confusing differences in common design process models. Following this, the article will attempt to distill what it is about these differing models that makes them the same to demonstrate how the use of different language may not be really different after all.
To find the similarities in differences, this article will briefly look at some different looking, yet common models to establish the common attributes that all of these models have.

The models that will be briefly analysed are:

- A NASA engineering design process (Figure 3)
- A human centred design process used at Stanford’s d.school (Figure 4) & by IDEO (figure 5)
- A double diamond design process (figure 6)

Then we will attempt to map:

- The Design and Production activities described on the Draft Syllabus document from NESA.

To begin, the NASA Engineering design process is one that we commonly see published in school resources. The process below is one of a few versions that have been published by NASA. In identifying the different use of language used in this model we can deconstruct some stages that are not present in the others found in this article. Compared to other design process models what is different in this NASA model is the explicit emphasis of particular design activities such as the ‘building’ of a model or prototype. From a technology education perspective, this stage explicitly insists on the engagement of practical ‘hands-on’ activities to make a model or a prototype. The explicit stages presented offer direction to beginner designers, and even offer direction in the type of evidence that a student could produce as a record of their design journey. As an example, the stage of ‘selecting an approach’ realistically is not a stage to be differentiated at all, however to ensure that students have considered the possibilities widely, the next step or stage asks students to converge the possibilities to make an informed decision (critical thinking).
The d.School, or the Hasso Plattner Institute of Design at Stanford University, is a design school that adopts a ‘human centred design’ approach to their design processes (Figure 4). After a quick search of the d.School process, you will find their process can be represented as both a cyclical, and a linear one. Regardless of how it is presented, two of the major differences in this model to the NASA one is the language used in the broader terms that step away from specifying design activities and focus on a ‘Human Centred Design’ (HCD) approach. Similar to a user-centred design process used developing digital technologies, HCD models place a particular emphasis on the role of the designer as an ‘empathetic investigator’ (hence to empathise), to develop a deep understanding of the intended user in an effort to make a positive impact on their lives. From this empathetic perspective the designer will use a variety of methods to gain an understanding of how the situation requiring their design intervention relates to the user or client. Design activities to develop empathy require the designer to investigate their story based on how they feel, what they see, and what they experience. In this way the designer develops a deeper understanding of the context that has shaped the need. David Kelley one of the founders of Stanford’s Hasso Plattner Institute of Design or d.School was also a founder of the design company IDEO, and as a result, IDEO and the d.School share a common genetic ancestry. IDEO also follows a HCD process with the intention of improving the lives of people through design thinking and collaboration. As a result of their relationship, one would think that the language used in the two models would be the same, however this is not the case with only one word ‘ideate’ being common across the two models.

IDEO’s Design Thinking for Educators toolkit presents a linear looking design process, (labelled as the design process) that contains 5 phases. These broad stages suggest possible activities that designers could follow through the use of questions to prompt and direct the thinking of the designer (Figure 5). In an effort to assist all educators (not just technology educators who may be familiar with Design Thinking), IDEO developed this toolkit to use Design Thinking to address the challenges of teaching. Similar to the NASA model, yet different from the d.School model, the 5 phases have been deconstructed into specific design activities that provide opportunities for documentation or data to inform critical and computational thinking.
Another difference in the model’s appearance is where IDEO attempt to blend the concepts of their approach with the double diamond model (Figure 6) to illustrate opportunities for both divergent and convergent thinking. As a guide for educators to use design thinking in solving everyday problems from learning spaces to systems used, Figure 5. also deconstructs the five phases into possible activities that begins to resemble more explicitly stated design models. A copy of the IDEO toolkit can be obtained from: https://designthinkingforeducators.com/toolkit/

Incorporating some similarities of the thinking processes graphed in Figure 5 is the ‘double diamond’ design process model was developed by the UK Design Council in 2005. This model uses four broad stages to guide designers and encourage certain ‘modes of thinking’ (Figure 6).

What is different in this model are the concepts of divergent and convergent thinking. As indicated by the outward arrows in the Discover and Develop stages of this process, divergent thinking is required where alternatives are sort, creativity and lateral thinking are employed to entertain many possible solutions. During the Define and Deliver stages, convergent thinking is encouraged. This is where critical thinking occurs based on the synthesis and focused decision making gained from specific design activity outputs such as information, ideas and solutions.
The double diamond model is not necessarily be considered a linear process, and there are other examples of double diamond design processes explicitly indicate iterative processes of both externally across the two diamonds, and internally between the two halves of each of the diamonds. A good design resource based developed by the UK Design Council is the ‘Study of the design process’ where they look at eh design processes undertaken by eleven global brands (One to download).

After looking at some of the features, the language and the differences of the four design process models, the next stage of this article is to determine what the similarities are that categorises them as a model of the design process?

A starting point is to look at the motivating reasons why a process is being initiated? The reasons may be different, however the development of a solution is ultimately the same goal. Using the three pillars of sustainability, one can easily categorise motivating factors to be either social, economic or environmental. As an example, from a business perspective, a design team may be required to update a product, whereas a design student may be asked to identify a problem that could originate from of either of the three pillars. As a result, the models analysed in this article use language such as define the problem, or situation, discover an opportunity, or empathise with the user. Regardless of the language used, or the reasons for the designer to engage in the task, it is a situation that challenges/ or employs the designer to resolve it. From this broad perspective, all models succumb to a situation that motivate and drive the process.

A second common feature among the different models is the synthesis of the situation by the designer. This may be labelled as defining the problem, or the interpretation or understanding of the situation. From an empathetic perspective, no matter what the activity entails, it is the job of the designer to understand why the situation has occurred, then through a process of interpretation involving interrogating data to frame the task.
Those of us who were lucky enough to attend the 2016 IIATE Conference were able to listen to Assoc. Professor Martin Tomitsch from the University of Sydney’s Design Lab. Martin provided us an excellent insight into the common design approaches undertaken by design organisations, and the importance of understanding the need to frame the task ahead when planning and managing design activities.

“A third common characteristic of design models is the encouragement of creativity and the development of an expansive array of ideas including those that may initially appear to be unorthodox. Looking through the lens of a technology educator, trying to encourage students to engage in divergent thinking is not easy as some students want to fly through the designing and planning to get straight to the making. To ensure that there is a record of creative opportunities, the NASA and IDEO models suggest design activities that result in the documentation of divergent thinking outputs. These outputs are evidence of creative thinking processes that are generated from explicit design activities such as sketching and brainstorming and are useful to use as teachers looking for evidence to assess student learning.

What is also common among the different models is the next step that follows creative and divergent thinking – convergent thinking. This is the immediate narrowing of the possibilities as designers make informed decisions based on data or evidence. In a general sense, this is the use of critical and / or computational thinking where designers synthesise information and make informed decisions that take potential design solutions in one direction or another. Decision making is crucial to all design processes and through the engagement of critical and computational thinking, designers can explicitly justify ‘why’ specific design decisions were made. As an example, the data used as to aid convergent thinking can vary from a page listing pros and cons, to the deconstruction of the problem into parts and testing of prototypes. The information that these activities provide, are analysed and enable informed decisions can be made.

Figure 7. Martin Tomitsch. Quote courtesy of Martin Tomitsch’s (2016) IIATE Conference presentation

“70% to 80% of new product development that fails does so not for lack of advanced technology, but because of a failure to understand users’ needs.”

Von Hippel, E., 2007
(MIT Business School)
Finally in elaborating on what is common amongst these different design models is an expectation that the designer will continue to work on the design until there is some level of satisfaction with the outcome. As we know, designers like James Dyson have worked on numerous iterations of designs until they feel as though the solution satisfies the brief. In the NASA model, this expectation is reinforced in not only the circular model, but the explicit stage titled, ‘refine the design’ where refinement would be based on feedback form the client or user. The IDEOs model, has a phase labelled as ‘evolution’, indicating that following this process, the designer may not ‘get it right’ and another attempt is needed, but now with the added advantage of experience in knowing what didn’t work and what might now work!

The d.School model has been represented as both a circular and a linear one. But the reference to iteration is not purely the circular arrangement. To support the concept of iterative design, the d.School process implies an iterative mindset through the use of the term ‘test’. It is through testing that the designer or user, conducts an assessment of the design to determine whether it satisfies pre-determined criteria, or whether the designed solution needs to return to an earlier stage in the process for re-designing.

The double diamond model presented as Figure 6 does not display where iterative design process are encouraged, however a short look through similar models found on the internet will show examples that demonstrate where iterative opportunities could be applied. That is not to say that this model does not support iterative design processes. Found in some double diamond models are listed examples of design activities (or outputs) under each stage of the diamond. Some models use the term ‘prototype’ listed under the Deliver section of the model. The use of language such as ‘prototype’ suggests that the design solution is not finalised and further work, or refining would be undertaken in the future based on appropriate data or feedback.

Other versions of the double diamond model overtly demonstrated an iterative design process as opportunities to refine result in the designer revisiting earlier stages of the process to get the solution right! This is illustrated in Figure 8. What this model also suggests is that opportunities to refine can occur in the develop stage where the information gained from developing prototypes may lead to opportunities to redefine the design incorporating the types of thinking such as critical or computational thinking.
What does this mean for us as teachers who teach design?

The new NSW Draft Syllabus for Consultation document, presented to the TechEd community for consultation, highlights to us the different ways that design processes or ‘design and production’ processes can use language to suggest particular stages or phases of a design. In looking at the models presented in this article, even though the language is different, and the appearance of the design process model is different, the intentions of these models are relatively similar.

To test whether the design and production process in the NESA document contain the same characteristics as the models presented in this article, the answer is yes!

Put simply, the NESA document presented an elaboration of design and production activities, without the need to recreate a graphical representation of a design process model. What we have learned in this article is that the differences in the language of labels, and the graphical arrangement of design stages may not be as important as we may think as long as the design activities incorporate what appears to be common design characteristics to ensure that the required rigor in the design process has occurred.

The use of graphical models, particularly those that consist of a small number of broader terms, do invite opportunities for and misinterpretation and misunderstanding where the terms used can discourage flexibility if they are interpreted literally.

Figure 8. Double Diamond model with refinement to demonstrate iteration.
Revisiting the three pillars of sustainability, the reasons for undertaking design activities vary, and as a result, may require different design activities that desire different design outputs. Different from the economic motivations of a business looking to renew a product, the design and production activities listed on page 18 of the NESA syllabus discuss the opportunities where students are able to “demonstrate their knowledge and understanding of technology”. Residing in the social context of enabling and educating students as contributors to the future, technology education is in the business of developing “confident users and developers of technologies” (NESA, 2017 p. 10). As a result of these motivations, the design activities that NSW school students engage also require production activities. This provides students with richer experiences and provide opportunities for students to experience a full range of design and production activities that will differ from some design organisations.

Design activity outputs such as justify the use of a range of tools, safely use a range of tools, and use graphical representation techniques are useful to educators as these artefacts become evidence for the assessment of student learning and provide a degree of rigor to the design process. In this context, the design processes undertaken are appropriate and suit the nature of the design activity.

Some final words on design iteration. The reality is, for teachers who are teaching students the authentic application of the design process, time is a limitation, and our students (like designers in industry) have specific deadlines to work to. As a result, opportunities for iterative design processes are limited, but understanding of the concept of iterative design as a mindset can still be taught as an expected mindset and practice where a ‘backward’ step must be taken in order to move forward. It is also important for students to know that this iterative mindset occurs throughout the design process and is not confined to specific stages such as an ideation stage. The Delft circle of thought image on the left demonstrates a continuum of thought or “empirical cycles” from trial and error processes (van Boeijen et al. 2013, p.19). In recognition of this iteration, we may initially see, and connect with a design process that is circular, but when we

<table>
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<th>NESA Design and Production process</th>
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<tr>
<td>Motivation for process</td>
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<td>Producing and implementing</td>
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<tr>
<td>Test, redefine, refine</td>
<td>Testing and evaluation</td>
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Table 1. Mapping of design and production to design process characteristics

“The design process therefore is flexible and adaptable to represent the dynamic nature of design activity”

Chung-Hung, 2014 p. 56

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account for the iterative nature of designing, we are actually seeing an end view of what could be described as a continuum of design activities.

**Additional reading:**
A recommended resource for design processes and methodology can be found on the following Danish site (In English) created by the University of Copenhagen, called Innovation and Entrepreneurship in Education: [https://innovationenglish.sites.ku.dk/](https://innovationenglish.sites.ku.dk/).

Also a publication that we need to take ownership is ‘Learning Through Doing’ published by AITSL in 2014. This publication guides educators in what we know and do everyday – encourage design thinking!

**References**


Tales from the classroom: Major Project 2016

Dhani’s story is just one of 1000s each year. Dhani Johnson studied Industrial Technology – Timber at Murwillumbah HS in 2016 under the guidance with his Industrial Technology teacher Marty Naughton. This is a brief look into the wonderful result that occurs when teachers and students collaborate on that special capstone piece of work- the major project!

Dhani could you tell us why you chose to make a guitar as your Yr 12 project?

Initially I intended to build something easier and achievable, but something that I could use, yet still score well. When the idea for a guitar came into my head I was hooked! I’d seen and played custom guitars before, but until now the thought of creating my own was inconceivable. After a little more consideration I wasn’t completely convinced that it was possible, but I intended to find out.

I have been playing since my grandmother bought me my first guitar 8 years ago. Music has always been encouraged in my father’s side of the family, especially guitar and piano, which I guess stems from my grandfather, Wally Johnson. Wally Johnson is my grandfather on my dad’s side, and is probably where the music started in our family. He always had lots of guitars and I’m lucky enough to have a couple of them. He’s also the author of the Australian nursery rhyme ‘A home amongst the gum trees’, the home mentioned in the song is actually where I grew up. I never got to meet him, but I hear about him all the time at Christmas dinners and birthday lunches, so I feel I know him at least a little, but it would have been cool to have had him play my guitar. It turns out he taught Shelly, Mr. Naughtons wife, guitar lessons when she was young.

What distinguishes your guitar from any other guitar bought in a music store?

I feel like the difference can only really be experienced by me. I built this guitar specific to me in every way. The body is the perfect size for my body and my style of playing, and is made out
of materials that seems to further emphasise that style. To make the guitar feel familiar, the neck was shaped to a similar curvature to that of a guitar I had practiced on since I was young.

The visual aspects of the guitar such as the rosette around the sound hole, the bridge and the head were all designed by myself with the goal in mind to create a guitar that looked as beautiful and unique as it sounded.

There is no other guitar like this one in any music shop, but what distinguishes this guitar the most is the connection I feel with it when I play it, which I don’t believe I have ever, or will ever experience from any guitar in a music store.

Has anyone other than you played the guitar? What feedback have you received about the sound it produces?

Three people have played it so far. The first was a friend of mine. He was at first was too afraid to touch it, but once he played it didn’t seem as though he wanted to let go. The second was a man whose profession was in the appraisal of instruments. He told me that any professional would be proud to make a guitar that looked as good, while producing a ‘warm’ sound. The third was my old guitar teacher who simply said “it suits you”, which I assume was a compliment, though I can’t be sure.

With regards to the construction of the guitar, what timbers did you use, and was there a reason why particular species were chosen?

Timbers used for instrument construction are called ‘Tonewoods’, and combinations of different Tonewoods result in different sounding guitars. Since the guitar I intended on making was relatively small and had a small body, so I had to compensate with timbers that would give it a bigger sound. I chose Indian Rosewood (*Dalbergia latifolia*) as it is known for having a warm and vibrant sound while also being exotic and beautiful visually, paired with quartersawn Sitka Spruce (*Picea sitchensis*), which is a very light softwood that would give it a bigger sound. I could hear the guitar’s sound long before it had been made.
How did you manage your time to finish the guitar?

By putting in the time I suppose. I would often put my free period and at least one of my breaks into working on the guitar, plus a few hours after school. And of course for every hour I worked Mr. Naughton would be in the workshop working as well, for which I am very grateful. I know he enjoyed the challenge as much as I did, but it was still a lot of extra hours, and extra tools that he needed to buy. A key example was a set of planes, the smallest of which was smaller than the end digit of my finger, but I can’t begin to express how wonderful it was to always have the right tool for the job. So of course, he is the reason that I got it done.

What advice would you give to a Yr11 student who is thinking of making a guitar for their major project? I’d say Prepare for frustration. Also, try not to break anything, because the super glue gets everywhere, and lastly, hang in there, because it will likely be the most satisfying experience of your high school life.

You suggest to Yr 11 students to be prepared for frustration. What exactly are the aspects of guitar making that are frustrating?

The construction of a guitar requires precision, practically beyond the capabilities of the naked eye. In order to make
the join in the soundboard as invisible as possible, I had to make the two pieces join on a single grain line. Later on I had to use a contraption that hung two small magnifying glasses in front of my eyes in order to cut a mitre joint that was a full 1mm wide. The join of the neck to the body took me easily over a week to get right. The problem was, almost every single process had some ridiculous aspect like this, but the relief you experience when it finally works is indescribable.

Dhani, you should be very proud! What you have created is something beautiful and like so many others that have come before you, the knowledge, skills and experience is priceless. When you undertake a major project for the HSC, it is not just yourself, but your teachers and family also walk this journey with you. Stories such as yours remind us (teachers) of how privileged we are to work with, and influence young people like yourself. Are there any final words, or people who you care to shout out to?

I’d like to thank Mr. Naughton for all of the extra hours he put in to get all of us cross the finish line, for answering our countless questions and for helping us with the occasional emotional breakdown. I would also like to thank Daryl wheeler, the professional luthier that helped us along every step of the way.
Institute of Industrial Arts Technology Education
Technology Education Conference 2017

SMC Conference Centre - 66 Goulburn St, Sydney

Thursday 19th October  
Day One
Hands on Technology'  
9:00 - 4:30pm  
(8:15am for registration)

Friday 20th October  
Day Two
Conference  
9:00 - 4:30pm  
(8:15am for registration)

Saturday 21st October  
Day Three
Conference  
9:00 - 4:00pm  
(8:15am for registration)

Thursday 19th October  
Evening One
Conference Welcome  
6:00pm - 10:00pm

Friday 20th October  
Evening Two
Conference Dinner  
6:30pm - 10:30pm

This conference is provided by the iiate as a forum for all teachers of Industrial Arts and Technology. The conference consists of an all day Hands On workshop course on Thursday, followed by a two-day conference including two auditorium presenters and breakout workshops, as well as two evening events. Delegates may choose which combination of day and/or evening events they wish to attend. All teachers are encouraged to attend. Guests are welcome to attend the evening events.

The information presented at this conference relates directly to the teaching of Industrial Arts and Technology curriculum. Teachers are provided with the opportunity for networking, resource sharing, skill development and advancement, and to be kept abreast of current and future directions in STEM education, focusing on Engineering and Technology.

Lunch and morning tea are provided. Schools will need to provide casual relief for conference attendees.

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<th>Non Member</th>
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There is no GST component in the cost of this conference as the Institute is exempt from GST.

Your IIATE membership must be renewed prior to registering for the conference, as you need to use your unique membership number to get the Member rate.

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conference@iiate.asn.au  
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Grant Byrne  
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web@iiate.asn.au
Jenny Irwin  
admin@iiate.asn.au

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Australasian Journal of Technology Education
Canadian Journal of Science, Mathematics and Technology Education
Design Issues
Design and Technology Education: an International Journal
Journal of Technology Education
Technology and Engineering Teacher
International Journal of Technology and Design Education

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In the Storeroom you will find a brief number of digital resources available to IIATE members

- Technology Education Associations
  IIATE NSW
  DATTA – Australia (includes links to all State Technology Education Associations)
  DATA – UK  ITEEA – USA  TENZ- NZ

- Related Associations
  The Warren Centre
  Re-Engineering Australia Foundation

- Events
  ITEEA 2017 Conference. Dallas, Texas 16-18 March, 2017
  Engaging and empowering decision makers through integrative stem education
  DATTA Qld Conference 22-23rd of June, 2017
  Design & Technology: The Human Element
  Technology & Engineering Education – Fostering the Creativity of Youth Around The Globe.
  NSW IIATE Annual Conference, Sydney. 19-21st of October, 2017
  TENZ/ICTE Conference, Christchurch. 8-11 October 2017
  Technology: An Holistic Approach to Education