

Enhancing Teachers' Understanding of Young Students' Learning in Technology

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Abstract

This paper describes a study of a tool used to develop teachers' understanding of teaching and learning and the formative assessment of students aged four-seven years of age in technology education. The research is aimed at assisting teachers' understanding of learning in technology through the use of an observation and questioning framework, a tool to formatively assess aspects of technology. This study applied aspects of the theory of building learning power to facilitate the development of dispositions and attitudes including the building of students' confidence and self-belief in their capabilities, within four aspects of learning and across five pre-determined behaviours relevant to technology education. The study employed qualitative research methods to assist teachers in the use of the observation and conversation framework aimed to improve their ability to formatively assess their students and their ability to give specific feedback in technology. The framework was presented to the teachers in three countries, England, Sweden and New Zealand, prior to teaching. Subsequent observations and interviews were used to gauge teachers' developed understandings of students' thinking and learning in technology. Their opinions and recommendations for improvements of the framework were also sought. The study shows that framework presented a number of benefits for teachers in two areas. It gave them considerable insight into aspects of technology and how students learn in technology and it also enhanced teachers' understanding of technology and student behaviours that influence learning.

Keywords: *Formative Assessment, teachers' understanding, dispositions, primary, early childhood, aspects of technology, technology education*

Introduction

Research undertaken to develop a tool, the Technology Observation and Conversation Framework (TOCF), to assist teachers' understanding of and students' learning in technology for students aged from four to six years is reported in this paper. It presents the final framework and teachers' views on how they were assisted by the framework. The study offers an international perspective on ways to broaden and deepen students' understanding in technological literacy and contributes to the field of formative assessment in technology education. This research was undertaken in three countries, New Zealand, England and Sweden, all with a high reputation in technology education. Teachers of four to six year old students were given the proposed framework, which they used to inform their conversations with their students while engaging in technological activity.

Learning in Technology Education

Learning technology presents teachers with a challenge of equipping students with skills and knowledge necessary to thrive in their current and future worlds. Technology education should recognise and enable students to be mindful of the future as they use, critique, design and develop technological outcomes (Snape & Fox-Turnbull, 2011). Wagner (2008) advocates seven skills vital for success: critical thinking and problem solving; collaboration across networks and the learning by influence; agility and adaptability; initiative and entrepreneurialism; effective oral and written communication; accessing and analysing information and curiosity and imagination. Claxton, Chambers, Powell and Lucas (2013) discuss the building of learning power within students through

the development of dispositions and attitudes including the building of students' confidence and self-belief in their capabilities, within four domains of learning rather than the building of specific sets of skills. Within Claxton et al.'s four domains: resilience, resourcefulness, reflectiveness and reciprocity sit a number capabilities, some of which are particularly relevant to technology education such as: noticing, perseverance, managing distractions and absorption in the resilience domain; making links, questioning and imaging in Resourcefulness; planning and distilling in Reflectiveness and collaboration, empathy, inter-dependence in Reciprocity. Claxton and colleagues (2013) state that increasing students' curiosity, sense of adventure, perseverance, and independence along with teaching students how to be better learners increases also their capabilities.

Conversation and collaborative learning play important roles in the learning of technology (Fox-Turnbull, 2013). Most of the capabilities and behaviours mentioned above are better facilitated if students are working collaborative and talking to each other and their teachers. Funds of Knowledge (González, Moll, & Amanti, 2005) also play an important role in learning in technology. They include knowledge and skills students bring to learning from their cultural and community experiences and that subsequently influences their learning. Fox-Turnbull (2016) in previous study identified that students draw on their funds of knowledge to inform their technology practice. Assessment of students' learning and development in technology involves intelligent observation of and conversation with students by teachers with the purpose of improving students' technological literacy (Compton & France, 2007). National or state curricula such as New Zealand's national curriculum technology achievement objectives (Ministry of Education, 2007) and the United Kingdom's Key Stages (Department of Education, 2013) in design and technology (d&t) go some way to identifying progression in technology. Compton and Harwood, (2005) Jones (2009) and Pellegrino (2002) suggest more research is needed around the notion and specifics of progression in technology.

This Study

This research was situated within a sociocultural paradigm and employed interpretative qualitative research method (Ritchie, Lewis, McNaughton Nicholls, & Ormston, 2014) through the application of the TOCF by teachers to assist them in broadening their understanding of students' learning and to facilitate the giving of relevant feedback to students as a part of the formative assessment process in technology . Data was gathered over a six month period in 2016. The main data came from pre and post semi-structured interviews with six teachers. Data was triangulated through researcher observations and audio recording of teachers' conversations with students. Data analysis occurred through repeated coding and recoding to enable a rich description of the teachers' experiences using the framework. After the analysis of early data the framework presented in this paper was modified after all the initial interviews were undertaken.

The Participants

Six teachers took part in the study, two each from New Zealand, England and Sweden. All teachers taught five and six year old children, teachers in UK and Sweden also taught four year olds. In Sweden this was in an Early Childhood setting, in New Zealand a primary setting and in England the school included both early childhood and primary children. Pseudonyms are used to protect the identity of the teachers.

- Teacher 1 (M) had taught for nine years and learned technology education as a part of his initial teacher training. He enjoyed teaching technology although admitted he was not hugely experienced at it.
- Teacher 2 (Am) was a beginning teacher who had no specific technology education in her initial teacher training programme. She had never taught technology before the study but did observe it being taught on one of her practicums.
- Teacher 3 (K) was an experienced primary teacher of nine years who moved into just teaching technology three years previously. K had no formal training in technology before

obtaining her position. She took a number of classes to upskill herself in technology but was given limited professional development in the technology curriculum.

- Teacher 4 (Ji) was a very experienced primary teacher with 19 years' experience. She then took an 18 year break before joining her current technology department as a specialist teacher assistant. When entering her current department she was given some ad hoc professional development in safe use of machinery.
- Teacher 5 (Je) has 18 year teaching experience who worked with students from 1 -6 years of age. As an ECE trained teacher she received no technology education training in her initial teacher education programme
- Teacher 6 (An) was also an experienced teacher of 19 years who worked with students from 1 -6 years of age. Again as an ECE trained teacher she received no technology education training in her initial teacher education programme and was heavily influenced by the Reggio Emilio philosophy of teaching.

At the point of the first interview teachers had varying understandings of technology. All understood that technology was about the 'made world' and that students designed and developed technological outcomes. Only some understood the need to understand the impacts of technology on people and places.

Technology Conversation Framework (TOCF)

The Technology Conversation Framework (TOCF) identifies five behaviours: resilience, transference, flexibility, reflection and socialisation. The first behaviour is Resilience and includes capabilities of perseverance especially after initial failure, managing distractions from peers, other activities and people around them, and absorption in any given task. Absorption, likened to Csikszentmihalyi's (1990) state of 'Flow' is described as a state of deep absorption in an activity that is intrinsically enjoyable, as when artists and athletes are focused on their play or performance (Shernoff, Csikszentmihalyi, Schneider, & Shernoff, 2003). Transference includes making links to technologies experienced or seen, and experiences undertaken previously such as using existing cultural knowledge and experiences or Funds of Knowledge (González et al., 2005). Flexibility and Sophistication indicate a depth to understanding as well as an openness to new and potentially strange ideas. It involves use of reasoning to evaluate and distil information received in order to understand what is learned from an experience. Spendlove (2015) identifies strong societal benefits of being creative within technology education and that increased sophistication of ideas may lead to improved creativity. Reflection describes the strategic and self-managing aspect of learning and includes the planning and anticipating of needs and potential issues and distilling information for potential of future use. Finally Socialisation identifies with the inherently social nature of technology and its huge physical, social and environmental impacts. Whether engaging in the use or the development of technology students will be interacting in a social manner. They may be collaborating with others to develop single or parallel technologies, they will experience interdependence, or the balancing of self-reliance and socialisation, as the need for resources and skills arise. Even when interacting with technology in a solitary manner students are still engaging with people.

These behaviours incorporate cognitive, social and physical behaviours. Within each behaviour are a number of capabilities which informed the development of the questions and the "look for" statements in the framework and to assist teachers in the recognition of the behaviours. The behaviours and capabilities are outlined in Table 1 below.

Table 1: Potential Behaviours Underpinning Success in Technology

Behaviours: Demonstration of:	Resilience	Transference	Flexibility & Sophistication	Reflection	Socialisation
Capabilities	Perseverance Managing Distractions Absorption	Making Links Imaging Noticing Questioning	Planning Distilling Reasoning Imagining Capitalising Evaluating	Questioning Distilling Revising Meta Learning Evaluating	Empathy & Listening Collaboration Interdependence Imitating

Each behaviour was subsequently extrapolated through five aspects of technology education common to the three countries involved in the study. The aspects include students gaining:

1. an understanding of their technological (made) world
2. the ability to evaluate (analyse and critique) current technologies
3. the ability to identify potential technological problems, needs or opportunities
4. the ability to design and make technological outcomes to meet identified needs using a range of materials
5. understanding of key concepts and processes unique to technology and deploy these in their practice where applicable.

In each aspect and across all behaviours potential student actions and teacher questions were written to assist teachers in developing understandings and recognition of students learning in technology. The teachers were given the framework at their first interview. Modifications were made to the TOCF after each round of interviews in response to participants' feedback. The completed TOCF can be found in Appendix 1.

Using the Framework

During the study the framework was used by all teachers as they worked with their students undertaking technology activities. The teachers felt they that needed to be familiar with the framework before using it with the students and most found the questions more useful than the aspects to 'look for'. Most said this was because they were easier to recall. All teachers indicated that framework assisted in developing their understanding of the breadth and depth of learning in technology and that it assisted their questioning and teacher/student conversations about technology.

Findings

The Technology Conversation framework (TOCF) offered assistance to teachers in understanding underlying key aspects and concepts in technology through the recognition and identification of the identified behaviours. Assessment occurred as teachers and peers listened to, watched, and interact with each other. In this research teachers used the TOCF to inform their interactions and observations of students thus assisting their ongoing formative assessment.

The findings from the study indicate that the teachers found using the TOCF as useful tool for developing their understanding and insight into student learning in technology. They also benefitted by developing deeper understanding of technology education (reported elsewhere). A number of recommendations for using the framework were suggested as well as feedback on potential disadvantages or issues with using the TOCF. Within the main theme reported in this paper five sub-themes emerged and are outlined in the Table 3 below.

Table 3: An Overview of Research Findings in the Main Themes

- Insights into students' learning and benefits for students when teachers were using the TOCF.
- Understanding technology practice process and concepts reflective practice and role of questioning
- Working collaboratively/ interactions between students including modelling
- Transference
- Motivation and engagement including using creativity and imagination
- Importance of resilience and ability to make mistakes without failing.

Insights into Students' Learning

Teachers felt they gained a better understanding of students' learning in technology in a number of ways. "The framework helped me to see that we can help the children even further in their progression of learning technology than we try to do today" (An). Participants gained an understanding of student technology practice and the role of reflection in student learning in technology as illustrated by A

They were really reflective and quite honest during that process.... They were very self-critical, which was interesting ...as it doesn't come naturally to this age. So we were able to seem them develop those skills of being critical of their own work and their own thinking. It was quite incredible (A).

And this by An "It has been fantastic to see how the children worked with the material and trying to build things from the real world, or new creative constructions that they are proud of". M realised that students were making ongoing design decisions to improve outcomes.

I think the conversations of some of the kids, I was going to use paper', 'well why didn't you use paper?' 'Because paper wasn't strong enough so that had to change' showed that they understood that it was still their design but they have made these changes to make it stronger (M).

Teachers gained insight into the benefits of the questions, illustrated by M in the following quote "It was so amazing really to see how much the questioning did enrich the learning and how it kind of lifted it up a level from where it would have been in the past....Children think at higher levels" (M). Teachers also realised the benefits for students of working collaboratively, how they modelled and learned from each other. Jn was surprised to see her four and five year olds working together. "Yeah, and solve problem, and I think it's possible to do itand they can do it together, and they find material, so built together to, and have own ideas when they collaborating together". Teachers also observed that students were also able to recognise that working with other people assisted their learning.

When we asked 'How did working with someone else help you and they kind of stopped and went 'yeah it did help' or they'd say 'no that didn't help', but they would stop and think about it and then give reasons why it was helpful (M).

The following extracts indicate that the teachers identified that the students were very motivated and engaged in their learning and therefore became more resilient as they were motivated to do a good job. "I asked them how they learned to build so fantastic together. For a month ago we built separately, and now we build together. So we have learned to use each other" (Jn).

I think because it was relevant to them so the idea that technology just this sort of farfetched thing for the professional, it can be something that relates to your needs and your life and the people around you so they kind of realised. 'Ok so I might not grow up to be a person who designs technology but I can still follow that process now through to the end', which is something quite cool (Am).

Teachers also developed insight into how students transfer knowledge from other areas of their lives to technology. In Sweden the students were engaged in designing a three dimensional

railway. “They had that three dimensional thing in their mind and then they pick up trains and try to use it so I saw we could work together. The students selected the context themselves, and Jn noted that most students used the train regularly with their parents and some parents were employed in railway construction. “It is very big project and for trains too, so I think, and we have parents who work to build train[s]” (Jn). In England K was impressed how her students transferred collaborative skills to technology to achieve positive results”.

I thought it was one of those moments as a teacher where you go, they were there, they were listening. It had sunk in, it had made a difference. It wasn't just me going blah blah blah. That gave me great joy, really gave me great joy, cos that's a life skill and they transferred it (K).

Teachers also noted how seriously the students took their work and that they were motivated and engaged in their technology practice as illustrated by Am in the following extract.

It was like a fun activity but to see how seriously they took it. It was like ‘this is my plan and I've got these materials and I need to make it’. They were thinking about how they were going to make it and what it was going to look like at the end (Am).

In New Zealand the teachers also specifically commented on the need to for the students to develop resilience. On seeing the framework for the first time M commented on the need for his students to develop resilience as they tended to give things a go once and then give up. The following extract from the researcher's journal “M very enthusiastic and excited. Could immediately see the applications in resilience particularly” (Researcher Journal 15 June 2017).

This understanding also assisted the teachers' recognition of resilience within the students later in their project.

so they understood that there wasn't a process of failure but that is something that everybody does and you can always look for what you can do better, and it was like ‘Oh, Okay!’ Mr M and Miss A can make mistakes so therefore so can I, I can admit them because it's not that I have failed.

Discussion and Conclusion

Snape and Fox-Turnbull (2011) state that technology and the principles of twenty first century learning are particularly compatible, this is clearly evidenced in this study. Through the asking the questions and observing student learning based on the five identified behaviours in the TOCF teachers were assisted in their teaching of technology by giving them insight into learning behaviours with the identified aspects of technology. Teachers tended to focus on one or two aspects of the framework at a time, but drew on questions from all of the five behaviours. In New Zealand and Sweden the teachers focused on Design, Make and Evaluate. In England Understanding the Technological World and Evaluate current Technologies. All teachers indicated that the other aspects would be useful in other units or projects, especially if available during the teacher planning process.

Teachers in this study stated that they could see the benefits of students developing resilience through the understanding that making mistakes in technology is a normal and indeed useful part of technology practice, rather than failure. This supports Claxton and colleagues (2013) stance on the role of resilience plays in successful learning. Transference was also identified by the teachers as making a positive contribution to students' learning in technology. In all classrooms students were clearly influenced and brought their Funds of Knowledge to their activity, as particularly illustrated by the students in Sweden who design a complex railway system. This supports in the literature on Funds of Knowledge (Fox-Turnbull, 2012; González et al., 2005) that students benefit from funds of knowledge transference to classroom learning, especially in technology.

The framework assisted teachers' recognition of the need to develop higher level skills and abilities of their students in technology. The study clearly illustrates that higher level questioning, reflection and collaboration play an important part in developing deep understandings of technology and technological practice. Teachers in England, including K who was the most experienced

technology teacher highlighted 53 of the 91 questions from the framework that they had previously or regularly used. Teachers in New Zealand and Sweden commented on how the questions assisted their teaching practice in technology. The ability for students to work collaboratively and to be reflective and self-critical surprised all the participants. The findings from the study clearly support Wagner's (2008) proposed essential modern survival skills and Claxton and Carr's (2010) dispositions necessary for learning and ability to build learning power (Claxton et al., 2013). Collaborative technology practice is common place, but perhaps less so in technology education, especially with young students who are perceived as not being able to work well collaboratively. This study indicates that collaborative practice not only occurs in technology but that students benefit from working with their peers, as was illustrated in both New Zealand and Sweden and supports Fox-Turnbull's (2013) study on the role of conversation in learning. Teachers developed insight into a range of ways students were able to work collaboratively, even at quite young ages.

A number of recommendations emerged from the study. Teachers suggested that the framework would be very useful as a tool to not only assist with conversations with students but also with their planning.

Also having it alongside when you are doing your planning and looking at times ...we went through and highlighted certain questions, it was suited to the activity that we were doing, so having that alongside your plan then you kind of look at it and going this is a skill that that we are really really rubbish at and need to build on this, you know like resilience is [one] of the big things that we are working on, and the transference and looking at those questions and go ok these are the ones we need to start feeding into and putting into what we are doing (M).

The New Zealand teachers suggested that a number of earlier activities they had completed before getting the framework might have been enhanced if the TOCF had been available. It would also have guided their earlier conversations with the students possibly maximizing the planned learning opportunities. The teachers in England wanted further clarity about contextualising the questions, rather than talking about technology in a generic way. All teachers suggested that users of the TOCF should become quite familiar with it before using it and felt that although this process was time consuming, it was worthwhile. Several teachers thought that the questions could be separated from the framework and enlarged and put on a ring binder system for implementation so that the questions were close at hand and easily accessible as teachers work with the students. One teacher was concerned about the amount of talking that using the framework involved but understood that the talking did not need to replace any practical activity rather occur in conjunction with it.

In conclusion the study's participants stated that using the TOCF assisted their understanding of how and what to teach in technology education and in helping their students' development in technology through the identified behaviours and across the identified aspects of technology. A further study could apply the framework over a larger number and wider range of students, in terms of ages, culture and nationality and accurately measure the impact of learning for students. Changes in teachers' understanding of technological pedagogical and content knowledge that occurred while using the framework could also be studied.

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Appendix 1: Technology Conversation Framework (Where the words have an * replace with the specific context of learning)

Behaviours Aspect	Resilience	Transference	Flexibility & Sophistication	Reflection	Socialisation
<p>Understanding of the technological world</p>	<p>Look for: using technology* and having repeated goes at getting it right or improving use of an existing technology.</p> <p>Total absorption while others are playing / working around them.</p> <p>Not letting others distract them.</p> <p>Hunting for the best device to do a particular job.</p> <p>Ask: How might you get better at using this technology*?</p> <p>Who might help you with this*?</p> <p>What might be a better thing to do this job?</p> <p>What can I do to help you with this?</p> <p>Say : Have another go. You are just not there yet.</p> <p>You can learn from getting things wrong.</p>	<p>Look for: transferring knowledge and skills in the use of one technology to another technology that might involve similar skills. Recognition of the similar skill sets.</p> <p>Deploying skills and knowledge used at home with a different technology at school.</p> <p>Recognising a range of 'made' things.</p> <p>Ask: Where else might you use this (action/ skills)?</p> <p>Have you done anything like this at home or with your family?</p> <p>Where have you seen this before?</p> <p>Have you used this before ? Imagine what this might look like in 20 (50/100) years time.</p> <p>What did you notice about the way that works ?</p> <p>What questions would you like to ask the people who made this ?</p>	<p>Look for: increasing understanding that technology is made for purpose. Different needs lead to different outcomes</p> <p>Students finding relevant information from unexpected sources</p> <p>increasing understanding that technology is made for purpose.</p> <p>Understanding different needs lead to different outcomes</p> <p>Ask: Who might benefit from this technology* ? Why ?</p> <p>How else might this be used ?</p> <p>What are the benefits of this ?</p> <p>What would you like to ask the person who made this to find out about how and why it works ?</p> <p>Which do you think is the better/ best (comparing a range of similar technologies*) ? Why ?</p>	<p>Look for: talk about why some things are made by people and some things are not.</p> <p>Questioning of how and why things work.</p> <p>Thinking about their thinking about technology.</p> <p>Ask: Tell me why this is technology?</p> <p>How might this be improved ?</p> <p>What works well ?</p> <p>What does not work well ?</p> <p>What do you think about when you use this technology? Why is this important?</p> <p>How can thinking help you understand this ?</p>	<p>Look for: understanding that technology is usually made by groups of people working collaboratively.</p> <p>Technology is made for people.</p> <p>Understanding that many people influence technology design.</p> <p>Attempting to use technology by copying the actions of adults.</p> <p>Ask: Who makes stuff (technology)? why ? Do you think people worked together to design and make this?</p> <p>How do you know?</p> <p>How do people work together to make this technology*?</p> <p>Give me an example of something that is/ is not made by people.</p>

Behaviours Aspect	Resilience	Transference	Flexibility & Sophistication	Reflection	Socialisation
<p>Evaluate current technologies</p>	<p>Look for: willingness to have a go at articulating the physical and functional features and nature of existing technologies.*</p> <p>Having several attempts at explaining the success or not, of technologies</p> <p>Having several attempts at getting something to work.</p> <p>Ask : What will make you better at using this?</p> <p>Say: Try again to see if you can get a different result. Use different words such as : better than, different to, similar to, not as good as when talking about this technology?</p>	<p>Look for: use of evaluative language used to discuss technologies in one context transferred to another.</p> <p>Ability to imagine a better version of technology.</p> <p>Noticing similar features from one technology to another.</p> <p>Ask: How could you improve this for another group of people (state actual group)?</p> <p>Why was this technology made?</p> <p>Who else might want to make this?</p> <p>What changes would they make? Why ?</p> <p>Have you seen this feature in something else?</p> <p>How have you used what we found out earlier about X in your plan?</p>	<p>Look for: increased awareness about the complexity of technology and that evaluations from different people will be very different.</p> <p>Understanding why what works for one person might not work for another.</p> <p>Imaging a more complex version or different version to better meet identified need.</p> <p>Ask: Why does this technology work so well?</p> <p>Who might this technology not work for ? Why ?</p> <p>Who might it work better for?</p> <p>What makes this technology safe to use?</p> <p>Say: Talk about successful design and ideas.</p>	<p>Look for: the ability to experiment with a technology and talk about how they might make it better.</p> <p>Children asking of questions as to why technology is the way it is.</p> <p>Questions about functional features.</p> <p>Questions about physical features.</p> <p>Ask: What makes this X* a good one?</p> <p>How could you improve it ? Why do you think this?</p> <p>How could this technology* be made safer to use?</p> <p>Would your parents (Mum, Dad etc.) use this technology*? Why?</p> <p>Would your parents (Mum, Dad) like this technology*? Why?</p> <p>Do you have the same or different ideas about this technology* than your parents ? Why?</p>	<p>Look for: recognition that designing and making technology* is frequently undertaken in teams.</p> <p>Understanding that to evaluate technology* a range of stakeholders -groups of people with a stake in the technology need to be considered.</p> <p>Comparing technology* using language of more advanced peers or adults.</p> <p>Ask: How might this technology* have been better if more people helped make it?</p> <p>How could other people help you to talk about how this technology* works?</p> <p>What do you think Mum or Dad {or another important person in their lives) would think of this ? Why do you say that?</p> <p>What features in this technology* help keep us safe?</p> <p>How do you know this made by people ?</p>

Behaviours Aspect	Resilience	Transference	Flexibility & Sophistication	Reflection	Socialisation
<p>Identify technological problems or needs</p>	<p>Look for: an understanding that investigation is need to identify potential solutions.</p> <p>Understanding and practice that the design process may have to be repeated to obtain eventual success.</p> <p>Ask: How many ideas do you think you need ?</p> <p>What would you change the second time if the first idea does not work ?</p>	<p>Look for: the ability to transfer potential solutions from other situations to an identified need.</p> <p>Ability to recognise that a problem can be solved with a technological solution.</p> <p>Ask: What have you seen that is a similar problem/need to this ?</p> <p>What do you know about recognising a technology problem from doing technology in school another time ?</p>	<p>Look for: ability of offer a range of innovative solutions to a single problem.</p> <p>Ability to recognise that a technology solution is needed.</p> <p>Imaging a more complex version or different version to meet a different need.</p> <p>Recognising that a solution in one area might be modified to assist in another.</p> <p>Ask: Rank the ideas you have to this problem from best to worst ?</p> <p>Tell me why they are in this order?</p> <p>What do you think might be the best solution to this problem ? Why ?</p>	<p>Look for: Recognition of what circumstances led to a particular technological need.</p> <p>The ability to recognise a range of possible solutions and that some solutions are better than others</p> <p>Ability to justify the above.</p> <p>Recognising oportunites for developing technologies.</p> <p>Ask: Which is the best design to meet this need, do the task required ?</p> <p>Why do you think this?</p> <p>What might be a better idea ?</p> <p>Within this situation or scenario what is the technological need ? (What needs to be developed ? Why?)</p>	<p>Look for: the understanding that conversation and working cooperatively can assist the process of problem/ solution identification.</p> <p>Understanding that working together can mean doing different tasks on the same project.</p> <p>Imitating adults in the articulation of a technological problem and /or solution.</p> <p>Listening to others for ideas.</p> <p>Ask: How can working together help you decide the best solution to the problem ?</p> <p>Who might help you think about doing this better ?</p> <p>How might you help others to recognise an opportunity or identify the need ?</p>

Behaviours Aspect	Resilience	Transference	Flexibility & Sophistication	Reflection	Socialisation
<p>Design & make technological outcomes to meet needs including evaluating their design ideas and outcomes</p>	<p>Look for: ability to continue working on a technology drawing/ model/ outcome to improve quality.</p> <p>Total absorption while others are playing / working around them.</p> <p>Not letting others distract them.</p> <p>Repeatedly giving things a go after initially failing.</p> <p>Ask: If your first idea does not work what will you do ?</p> <p>What other detail can you put in your drawing/ model?</p> <p>How might you improve the quality of your technology outcome ?</p> <p>Say : Try again to do this, but in a safer way. Like this (demonstrate skill)</p>	<p>Look for: skills learned in skills based lessons such as drawing, gluing, etc. used when making the actual drawing/ model/ outcome.</p> <p>Transferring identified attributes from design to the technology outcomes.</p> <p>Use of safe practices Use of research/investigation findings evident in planning/ drawing.</p> <p>Ask: What have you/we already learned that might help you with your drawing/ model/ outcome?</p> <p>Why/ How will this be useful ?</p> <p>How did you determine the attributes ?</p> <p>Who taught you to do that ?</p> <p>How did you know that ?</p> <p>Can you use (a feature) from something else?</p> <p>How can we do this safely ? How have you used in your planning what we learned about ?</p>	<p>Look for: detail in designs, ability to draw in 3D and annotate design ideas.</p> <p>Use modeling to inform technology practice and improve technology outcomes.</p> <p>Understand how modeling helps improve technology outcomes.</p> <p>Ensure design reflect required or desired attributes.</p> <p>Students drawing on relevant information from unexpected sources.</p> <p>Ask: Improve your design so that another person could make your technology outcome.</p> <p>Why and How does making a model improve you technology outcomes ?</p> <p>What attribute/ feature is the most important why?</p> <p>What is the best bit of your design ?</p> <p>What is your favourite part of the design/outcome ?</p>	<p>Look for: ability to self and peer evaluate outcomes against established attributes or characteristics.</p> <p>Ability to recognise and justify changes for the next iteration of the design.</p> <p>Ask: What are the best features of this drawing/ model/ outcome ?</p> <p>Why do you think this ?</p> <p>If you/ they were to redo this or make improvements what changes should you/ they make ? Why ?</p> <p>Can you make your plan ? What help might you need ?</p>	<p>Look for: ability to work collaboratively with others.</p> <p>Ability to engage in intercognitive conversations, let own ideas go if necessary and move to new thinking with others.</p> <p>Embrace knowledge and skills brought to the group by others.</p> <p>Listening to others for ideas.</p> <p>Ask: How does working with other people help you ?</p> <p>What ideas did you change after talking to X/group ?</p> <p>What knowledge and skills did you know that the others didn't know and that helped your group ?</p> <p>How can other people help you make your design ?</p>

Behaviours Aspect	Resilience	Transference	Flexibility & Sophistication	Reflection	Socialisation
<p>Understand key concepts of technology & deploy in their practice</p>	<p>Look for: ability to continue working on problem solving or developing a solution repeatedly after failure.</p> <p>Ability to name alternative suitable materials used.</p> <p>Ask: How can you make this better?</p> <p>What changes would you make next time ?</p> <p>Who will benefit most from this design ?</p> <p>Can you design it so others will benefit ?</p>	<p>Look for: key concepts (these will differ according to curricula) learned in one unit transferred to another.</p> <p>Tasks that are identified in real technology practice transferred to students' technology practice</p> <p>Increasing complex drawing and modelling skills in subsequent units or projects</p> <p>Ask: What groups of people may not like this technological outcome* ?</p> <p>What are the main tasks for a technologist (a person who designs stuff) ?</p> <p>What have we already learned that will help us with this design ?</p>	<p>Look for: increased vocabulary used when describing technology outcomes.</p> <p>Increasingly complex technologies recognised as technology.</p> <p>Increased complexity when considering factors that influence technology practice (theirs and others).</p> <p>Ask: What would a 'bad' technology look/ sound/ smell/ taste/ feel ?</p>	<p>Look for: describe the technological outcome they are making</p> <p>Identify why they are making a technological outcome.</p> <p>Use of attributes to evaluate design ideas</p> <p>Discuss what is and is not technology and why</p> <p>Identify who might use a technology and why</p> <p>Comparing of their outcomes with pre-determined attributes.</p> <p>Ability to undertake self and peer assessment against identified attributes.</p> <p>Ask: What groups of people may not like this technological outcome* ?</p> <p>What groups of people will like this technological outcome* best?</p> <p>Next time your made this what changes would you make ? Why ?</p>	<p>Look for: understanding the social and collaborative nature of technology and technology practice.</p> <p>Understanding the technology influences people and people influence technological development</p> <p>Ask: What groups of people may not like this technological outcome*?</p> <p>What groups of people will like this technological outcome* best?</p>