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Supporting conceptual understandings of and pedagogical practice in technology through a website in New Zealand

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Abstract This article reports on the up-date and development of an on-line resource to support of teachers' conceptual understandings and pedagogical practice in New Zealand. Techlink is a website dedicated to supporting technology teachers, students and those with an interest in technology education. This research documents part of a Ministry of Education initiative to develop materials to support teaching and learning in technology education. The research was conducted by educational researchers contracted through Technology Education New Zealand the professional subject association. This research was a component of a larger contract with an overall aim of improving student achievement particularly at Years 12 and 13, the final 2 years of schooling in New Zealand. The aims of the initiative reported in this article were to provide ongoing evaluation of the effectiveness of the materials developed by the writing team, to support teacher shifts in understanding and pedagogical practice. This article gives an overview of the 3 year research study, focussing on teachers and teacher educators perceptions of Techlink as a professional development resource. An iterative process was used to critique and give feedback on existing and developed materials. The article also discusses enhancements made to ensure that the resource reflected the needs of technology teachers and The New Zealand Curriculum (Ministry of Education 2007).

Keywords Teacher support · Technology education · Web based teaching resources · Responsive evaluation

Introduction

In order to improve student achievement in technology education the New Zealand Ministry of Education identified the need to support teachers by providing quality teaching

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materials to support learning. An initial contract led to the development of Techlink (http://www.Techlink.org.nz), a website aimed at supporting teachers in their delivery of technology education.

This article reports on research which was a component of a second contract aimed at evaluating the existing resource material and guiding the development of future materials. This research is significant because the Techlink website has been adopted as the main and official repository of support materials for the delivery of Technology Education in New Zealand. The Ministry of Education, in partnership with the Institute of Professional Engineers of New Zealand (IPENZ) enabled the development of a 'one stop shop'. Techlink caters for teachers, teacher educators, students and the wider education community by offering a range of relevant and up-to-date materials.

There is an increasing international trend towards professional development in education settings using web-based materials (Lee and Choi 2008; Van Zee and Roberts 2006). Techlink has the potential to support and facilitate consistent nationwide understandings of Technology Education in New Zealand. This article examines the effectiveness of the New Zealand experience.

Techlink

The Techlink website was established in 2003 with support from New Zealand Trade and Enterprise, through the Enterprise Culture and Skills Activities Fund. In 2005 a partnership between the Ministry of Education and IPENZ resulted in the continued development of Techlink to provide resources to support the planning and implementation of programmes in technology education. The site contains a range of materials including such things as case studies of classroom practice, technology practice case studies, curriculum support material and assessment information and examples.

Rationale

Concern has been raised about the conceptual understandings of technology, pedagogical practice, and student achievement in Technology Education within New Zealand (Compton and Compton 2010; O'Sullivan 2007). Developing teacher knowledge in technology is critical to the implementation of technology education (Fox-Turnbull 2006). Teachers need to have a clear understanding of the nature of technological practice so that they can facilitate quality authentic programmes for their students. An important philosophical consideration in this research was the need for teachers to understand the importance and place of authentic technological practice (Fox-Turnbull 2006) meaning that students need to be involved in practices reflecting understanding of the culture of real technological practice. Skills and knowledge are far less relevant and meaningful if taught in isolation and students have a right to understand the relevance and place of their learning (Hennessy 1993; Turnbull 2002).

The research investigated and informed the quality of resources developed for inclusion on the Techlink website. The purpose of Techlink is to enhance teachers and students' understanding and performance in technology education. It has become the main repository for all technology curriculum related material in New Zealand. Techlink has utilized significant funding from multiple sources and as such required investigation and examination to ensure consistency and quality of the website and the materials located on it. The initial goals of the research were to critique resources used by teachers in technology especially those on the existing website, establish criteria for the evaluation of current and

new material and apply findings to enhance the website. Then in response to identified claims issues and concerns raised additional intentions were identified. These included assessing the effectiveness and usability of Techlink and shifts in teachers' understanding and pedagogical practice following engagement with the improved and updated website.

Main research questions

How can commonly used resources in technology be enhanced to improve effectiveness for teachers?

Do quality resources enhance teachers' pedagogical and content understandings of technology?

The purpose of this research was to provide action-orientated guidance to the developers to improve the Techlink website and to assess the effectiveness of the improved website in developing teachers' pedagogical and content knowledge and understanding. The research design utilized needed to be responsive to key issues and problems recognized by both the developers and users of the website.

Methodology

The main body of the research used a qualitative approach through the gathering of participant experiences and opinions while engaging with the Techlink website. Quantitative data supported the research in the form of a baseline survey. The methodology used for the main body of research was Responsive Evaluation, as described by Guba and Lincoln (1989). Responsive Evaluation is organised through claims, concerns and issues. This research utilises four basic methods for generating information and making decisions with regard to these organisers. All data gathering methods used in the study: baseline survey, focus group interviews, some preceded by set tasks and on-line forum are widely used and tested by applied social scientists. Techniques including the hermeneutic dialectic are employed. Stakeholder constructions are investigated, challenged, and contrasted to help develop new meanings. For example, in this research constructive debate occurred during facilitated meetings and exercises. In this manner, all participants' thinking was shared and challenged in order to develop common understandings and indications of a way forward. The majority of data presented in this article stems from these conversations. Participant perceptions were explored and challenged which resulted in an iterative process leading to developmental changes on the web site.

Scope of the study

The study was a five phased study outlined in Table 1. The research was an iterative process with on-going dialogue between the researchers and the participants and the researchers and the resource development team as can be seen in Fig. 1.

The first phase investigated teachers' opinions of all the resources being used to support technology at that time. It consisted of a baseline survey distributed to members of Technology Education New Zealand (TENZ). TENZ is a voluntary subject association which aims at supporting the delivery of quality technology education programmes throughout New Zealand. Teacher Surveys were sent out to 60 schools 20 primary, 20 intermediate and 20 secondary schools across the six TENZ regions covering the whole of New Zealand.

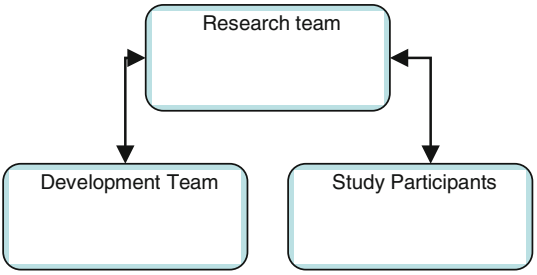

Fig. 1 Configuration of the three groups of people involved in the study

Table 1 Overview of the five phases of the research

Phase	Tools used	Purpose
Phase one	Baseline survey to TENZ members	To ascertain resources used by teachers in the delivery of technology education and the extent to which resources are considered useful
Phrase two	Focus group interviews: round one in four locations with two subgroups	To ascertain first critique of Techlink and of the resources housed on the web site
Phase three	SWOT analysis and evaluation framework development	To develop a framework for the critique of current and future resources and subsequently critique effective of changes undertaken from feedback given to the developers by the focus group meetings
Phase four	Two more rounds of focus group interviews; rounds two and three in three locations preceded by facilitated tasks as a basis for discussion	To ascertain the effectiveness of changes made and to inform future changes
Phase five	A fourth focus group interview and online task for student teachers and interviews with experts	To ascertain how engagement with the resource made shifts is teachers' (including student teachers) pedagogical and content knowledge and understandings of technology

The aim of the survey was to identify resources used by teachers to support delivery of technology education and their opinions of the resources they used. It also sought to find out whether or not they had ever engaged with Techlink.

Four rounds of focus group interviews followed the initial baseline survey. The focus group interviews occurred at approximately 6 monthly intervals over a 2-year period at three or four locations around New Zealand; each with their own schedule and purpose. In each region the same questions and strategies were used during each round. All focus groups consisted of six to eight people, including teachers of primary and secondary students and teacher educators. The participants of the focus groups were accessed through regional networks of TENZ. Participants were informed volunteers selected by the regional chair-people and most attended all four focus group meetings. Each of the focus group interviews were recorded transcribed and checked for accuracy. These transcriptions were then analysed for claims concerns and issues and coded accordingly. The codified aspects were reported on and helped inform the research process through a series of recommendations made to the developers. The codes used at the end of the quotes in this article represent the region and the round of interview, for example (HM4) represents Hamilton focus group in Round Four.

The second phase was specifically targeted at identifying teachers' opinions of the Techlink website. This phase consisted of one focus group interview (Focus Group One) in four centres throughout New Zealand: Dunedin, Christchurch, Auckland and Hamilton. All groups consisted of 8–10 people and included primary and secondary teachers and at least one teacher educator.

In the third phase the researchers undertook a SWOT (Strengths, Weaknesses, Opportunities and Threats) analysis of the existing resource types identified as used by teachers. They used this information and the information from the first baseline survey to identify specific criteria and develop a framework to be used to critique existing and future resources.

The fourth phase consisted of two more rounds of focus group interviews with three groups located around New Zealand: Christchurch, Auckland and Hamilton. In each centre there were up to 10 participants (these numbers were subject to variation given the participants' availability for the meetings). The participants were the same as those used in Round One where possible. The purpose of this phase was to improve the quality of modified existing materials and newly materials and resources available to teachers on the Techlink website. The focus interviews followed facilitated engagement with the new material. Feedback from these interviews was summarised and fed back to the Techlink development team in the form of recommendations, who then re modified existing resources and continued to develop new resources accordingly. This was an iterative process.

The purpose of Phase Five was to ascertain whether engagement in and interaction with the improved website shifted teachers and student teachers' pedagogical and content knowledge in technology education. The fifth phase started in the final 6 months of the project. This phase consisted of one focus group meeting at the three locations used in the fourth phase again with the same participants where possible and a range of on-line exercise undertaken by student teachers at Massey University. In Focus Group Four the teachers were guided through a number of exercises within the case studies and then presented with questions about the ways in which interaction with Techlink had enhanced their understanding in technology. In the student on-line discussion data about shifts in understandings were achieved by specific questioning. When they undertook this discussion the student teachers had recently returned from teaching practice. They were asked to use Techlink by visiting the following student case studies: Outdoor Shower, Multilayered Jam, Saddlebag for the Lambing beat *and* Remote Controlled Lawnmower to investigate how student capability is often underestimated. The student teachers were asked to respond on-line to the following comments often heard in schools: 'My kids can't do that?' and 'The kids in this school are not ready for this!' Looking at specific case studies and responding to these statements allowed the research team to gain insight into student teachers' understandings and perceptions of the technology presented on Techlink.

Results and discussion

Phase one

The baseline survey was distributed by post to 360 teachers across New Zealand. Of the 360 surveys sent out only 49 were returned. The research team were very disappointed with this return rate but felt that this was indicative of the realities and stresses of teaching technology education at this time. At the time a curriculum review was underway where

substantial changes were being imposed (Ministry of Education 2006). Despite the return rate the collection of baseline data helped to determine the project directions. The early concerns and issues were identified from this survey. Teachers were asked to list the resources they were currently using and rate them according to usefulness, 10 being extremely useful and 1 being not useful. Teacher answers were classified into eleven categories: Ministry of Education (MOE) publications, text or poster resources, curriculum documents, New Zealand Qualifications Authority (NZQA) resources, TKI (MOE website for teachers), *Techlink* (specifically mentioned), Tools and ICT equipment, video/TV programmes, photographs and internet (not *TKI* or *Techlink*). Forty-four percent of teachers reported using text and poster resources, 6% specifically mentioned the MOE published resources and 10% reported using the curriculum as a resource. 28% of teachers reported using the internet in general while 13% specifically mentioned *TKI* and 13% *Techlink*. Six percent of teachers reported using NZQA resources while 8% reported using the exemplars. It is important to note here the NZQA resources are specific to secondary schools while the exemplars are targeted to primary schools. Thirty percent of teachers used videos or taped TV programmes with their students and14% of teachers suggested using ICT equipment while 4% used photographs. These results are summarised in Table 2.

Of the seven people to who mentioned *Techlink* as a resource 5 rated it above 5, this equated to 63%, this is a lower percentage than any of the other resources mentioned. All those who used the exemplars or NZQU resources found them useful (above 5) and 90% of people using the curriculum and other MOE publications also found them useful. Of the people who mentioned video or TV programmes 80% found them useful, while 72% of people scored text/poster/photographic resources useful. In conclusion teacher used a range of resources to support their teaching, the least useful of which was Techlink; the most useful were the NZQA web site which specifically targets New Zealand secondary school assessment and the exemplars which specially targeted New Zealand primary technology education.

Phase two

Focus Group One interviews ascertained teachers' awareness of Techlink, and their perceptions of its effectiveness as a professional development resource. The participants valued the programme design information and the information with regards to the new curriculum (particularly the Indicators of Progression giving clarity to the Achievement Objectives). Teachers appreciated the easy links, not having to search for information on a

Table 2 Respondents rating of resources

Resources	Rated 8–10	Rated 6–7	Rated <6	% Rated >5
Techlink	4	1	3	63
TKI and internet	10	7	7	71
Exemplars	3	1	0	100
NZQA	3	3	0	100
Video and TV	9	3	3	80
Texts, posters and photos	9	7	6	72
MOE publications and curriculum	5	4	1	90

range of other websites and the fact that it was current and up-to-date. They also liked that information was current and relevant to New Zealand. They felt that the fact the Techlink was MOE supported gave it more credence with colleagues. Although, the participants thought the site had potential they thought it was very wordy and confusing. The participants initially found navigation of the site tricky due to the considerable amount of time it took to familiarise themselves with it. As one interviewee put it, "We want to 'skim and drill' rather than have to burrow" (CH1). Some other suggestions for improvement were made, these included: more hyperlinks to relevant primary resources; use of the site to show students' examples of authentic technological practice; the addition of 'Codes of Practice' for undertaking technological development; a reformatting of the existing workbook examples so that pages could be turned and printed. They also suggested the creation of digital stories of technological practice, for example the Technological Practice case studies in series of pictures for sequencing; and finally the though there was opportunity for more resources on the graphical design and visual communication domain, for example student show cases in the area and actual technological practice of people such as graphic artists and designers at work. A final recommendation was the development of student and industry case studies of collaborative technological practice with two or more people working on one outcome.

Phase three

In order to give purpose and structure to the focus group interviews existing resources were analysed and criteria for the critique of resources were established. Following the baseline survey and the first of the focus group interviews the research team identified resource types most commonly used and undertook critical analysis using a SWOT framework (Valentin 2001). The aim of the SWOT analysis was to identify possible strengths, weakness, opportunities and threats for each type of resource. This can be seen in Table 3. These resource types included photos and posters, videos, graphical representations, print materials and audio recordings. All resource types identified and selected for analysis were capable of digitisation and could be loaded to a web site if required.

In conjunction with the Ministry of Education Guidelines for the Development of Resources (Ministry of Education 2008) the research team then developed criteria for the critique of existing resources and the development of further resources were subsequently developed. These criteria were established under four headings or aspects which emerged from the data: Navigation, Content, Promotion and Layout (Table 4).

Navigation was selected because initial focus group feedback suggested that it was a considerable issue with the Techlink Site. The content of resources was also identified as a concern because much of the content at this time was based on the 1995 curriculum (Ministry of Education 1995). Promotion was recognised as a concern because of the number of teachers who had not engaged with the website. It was recognised that for the website to be effective teachers needed to know about it. Finally layout was identified as key to fostering engagement and keeping teachers in the site once they are on it.

Phase four

Phase Four occurred through Rounds Two and Three of the focus group interviews and exemplified the reflective nature of Responsive Evaluation research. Early suggestions for improvement were reported to the website writers to initiate the development process based on feedback about these four aspects: Navigation, Content, Promotion of Techlink and Layout.

Table 3 SWOT analysis

Media	Strengths	Weaknesses	Opportunities	Threats
Photos and posters	Real	They date	Break/question stereotypes	Copy write
	Vast information on one image	Resolution problems	Manipulate e.g. crop, sequence re-sequence etc.	Privacy laws
	Colourful/visual	Poorly staged photograph	Can be incorporated into other resources e.g. PowerPoint	Inappropriate use
	Easy to manipulate e.g. crop, sequence etc.	Photographical bias	Student auto-photography	Digital manipulation
	Hands on make class sets	May confirm stereotypes	Digital manipulation	Can be expensive can become dated
	Appeals to kinaesthetic and visual learners			
	Can be digitised			
Video	Real	They date	Can be incorporated into other resources e.g. PowerPoint	Copy write/licensing
	Contain vast information	May confirm stereotypes	Digital manipulation	Privacy laws
	Colourful/visual	Expensive to produce	Can engage reluctant learners	Inappropriate use
	Appeals to visual learners	Editing can mislead	Pod cast	Digital manipulation
	Part analysis	Media corruption		Can Need sophisticated hardware
	Part of popular culture	Need equipment to play		Broadband capability can become dated
	Ability to be copied			
	Can be digitised			

Table 3 continued

Media	Strengths	Weaknesses	Opportunities	Threats
Graphical representations	Visual	Need interpretation	Vast information in succinct manner	Layout and typography—clarity etc.
	Hands on	Can require prior knowledge to interpret	Can give instruction	Oversimplification
	Make class sets	Need to know conventions	Create new contexts/variety	
	Appeals to visual learners	Conventions can differ internationally		
	Conveys information easily/succinctly			
	Easy to adapt/modify/improve			
	Can be applied to a variety of contexts			
	Can be digitised			
Print material	Rich and detailed	Boring	Archival opportunities	Age appropriateness
	Easy to adapt/modify/improve	Need to be literate	Creative interpretation	Creative interpretation
	Easy access	Reading age applies		Can become dated
	Don't need electronic resources			
	Make class sets			
	Cheap and easy to copy			
	Varied			
	Can be digitised			

Table 3 continued

Media	Strengths	Weaknesses	Opportunities	Threats
Audio	Can be asynchronous or synchronous	Relies on hearing	Webinar (seminar on line)	Time zones
	Appeals to auditory learners	Not necessarily interactive	Podcast	No visual cues
	Portability (mobile phone down loads)		Global interaction	
	Popular culture		Interviewing	
	Some anonymity		Cheap networking	
	International			
	Can be digitised			
	Can be interactive			

Table 4 Techlink resource evaluation table

	Issues and criteria	Rating				
		1	2	3	4	5
Navigation	Simple to navigate					
	Trackable pathways					
	Use of codes for tracking and searching purposes					
	Sophisticated search function, use of multiple tags					
	Use of colour to aid navigation					
	One line synopsis of content for each section					
Content	Democratic (fair and balanced) in coverage of level					
	Democratic in coverage areas of technology					
	Coverage of curriculum					
	Informative					
	Current					
	Age suitability clearly stated					
	Accuracy					
	Coverage of the areas and aspects of technology					
Promotion of Techlink	Readily accessible to classroom teachers					
	Targeted at a specific market e.g. teachers, senior management, parents, or students					
	Visual and eye catchy, immediately appealing					
	Contain brief relevant information relevant to target group					
	Have a hook					
	Be a quality publication					
Layout	Sufficient space to prevent overwhelming/text overload					
	Consistency of layout overall and within					
	Consistency of colour overall and within					
	Clear and easy to read font					

Key 1 = criteria not met at all, 5 = criteria exceedingly well met

On-going analysis and critique of modified and newly created resources through the use of facilitated task and subsequent discussion occurred. The research team then supported and monitored changes as they were implemented, not only to evaluate the quality and effectiveness of the materials developed, but also to identify how the changes were perceived by participants. This iterative process (Neuman 2000) continued throughout subsequent rounds of qualitative focus group interviews some with facilitated tasks.

Content

The participants suggested information be developed on school programming in technology with explicit links to *The New Zealand Curriculum* (Ministry of Education 2007) particularly the Indicators of Progression for the Achievement Objectives. Another point raised was that teachers wanted a range of appropriate teaching strategies for technology, terms to be defined and explained and then subsequently that exemplars be developed using initial but *Techlink* case studies. Participants also indicated they wanted resources

with longevity, which were contextually based from New Zealand, visual in format and suitable across a range of levels of the curriculum. A number of the teachers mentioned that they also wanted resources specifically for the Visual and Graphical Communication teaching area of technology. They suggested student show cases of work from all levels, and actual technology practice case studies-graphic artists and designers at work, be developed. The research team had also recognised the need for further material to support the newly added digital technologies and graphical communications domains of technology. Another suggestion was the development of case studies showing the collaborative practice of students and also authentic technological practice. It was suggested that more examples of procedural information, student worksheets and student best practice be included on the site. Feedback from the second focus group led to the research team to recommendation that content be enhanced by:

1. The development of explicit links to the new curriculum, all three strands (a new curriculum with two new strands and the reorganisation of the previous curriculum into one existing strand Technological Practice, meant teachers were struggling with recognising components of the curriculum). The research team recognised that the Case Studies were written with the current Technological Practice strand in mind. Explicit links to the additional new achievement objectives would enhance their usefulness. It was felt that given the holistic nature of the current curriculum, most case studies would have evidence of, or implied learning from the two new strands, The Nature of Technology and Technological Knowledge. The research team recommended the simple use of headings and examples linked to these two strands and their associated component.
2. The development of specific and explicit links to Achievement Standards in NCEA (National Certificate of Educational Achievement is the officially recognised senior secondary school qualification of New Zealand). This was to include the explanation of and discussion surrounding the assessment of student work (for example-achievement, merit or excellence). The research team felt this would aid teachers in the development of their pedagogical understandings of technology and its assessment and possibly enhance teacher classroom practice.
3. The development of the Indicators of Progression (Ministry of Education 2009) and associated 'teaching environment' notes through the unpacking of the case studies at each level.
4. Further clarification and unpacking of new terminology.

The research team subsequently reviewed modifications to the website content using an evolved evaluative strategy. This involved the categorisation of aspects from Techlink against the components of technology from The New Zealand Curriculum (Ministry of Education 2007) and with the addition of appropriate suggestions for classroom application. This enhancement showed a broad coverage of the components in a variety of contexts with varied applications. The researchers were confident that the modified site complemented the full range of components and had the potential to support the implementation of recent changes to the achievement standards, and improving the content of the site overall.

Navigation

These issues were addressed directly after Round One and teachers' responses in the second focus group were mostly positive. When asked about improvements in navigation

one response from the second focus group was "[Navigation is] better but case studies could be grouped into curriculum levels as often the level is more important than the area" (CH2). Most feedback welcomed recent changes and acknowledged the improvements made. This is representative of Responsive Evaluation research where claims issues and concerns from the participants are addressed via the hermeneutic dialectic.

Promotion

Following the improvement of the navigation and content aspects of Techlink team (researchers and developers) determined that an improved website was not useful if teachers did not know about it therefore the researchers shifted their attention to promotion of the website. They subsequently decided to further enhance promotion of Techlink with guidelines for usage of material be developed for a range of potential users such as classroom teachers, school senior management, parent communities, and teacher education. Subsequently teachers reported using the improved site in innovative ways for example*:* "I have got Techlink on my school home page so that students, teachers and parents, when they are talking about subject choices Techlink explains everything" (CH3); "I've had a parent use it and they loved what they saw" (HM 3).

With the improved awareness of the site the website statistics suggested increased website hits and downloads. Focus group teachers reported using it as their 'first port of call' when planning lesson, units and programmes of work. One suggestion for improving promotion of the site was the creation of digital stories or sequenced photographs of technological practice that were specifically targeted to primary, intermediate, lower secondary or senior secondary aged students. This suggestion also reflected baseline data findings that participants valued visual resources, 72% of respondents scored poster and photographic resources useful.

In Focus Groups Two and Three the data also showed teachers were beginning to use the site in innovative ways: "I got it on my school home page so that students, teachers and parents are talking to their kids about subject choices then the Techlink site explains everything" (CH2); "I've had a parent use it and they loved what they saw" (AK2).

Layout

The layout of the site was identified as a concern in the initial stages of the research. Teachers reported that the layout was quite heavily text laden which they found time consuming and off putting: "I would like more diagrams or photos of the process rather than everything in text." (AK2). To make the initial scoping easier the research team recommended the use of developed graphics and existing pictures from the case studies to illustrate design processes and cycles. The data suggested that changes made to the layout and presentation of the website would facilitate easier use. Participants suggested these changes would stimulate and motivate potential and existing users: "It does help to have more sub headings on the page, so you can just scan it easily" (HM4); Participants reported that improved pathways throughout the site supported the needs of both curriculum leaders, syndicate members and teachers working to address individual needs: "Yeah, I mean I have seen my teachers saying, 'Look I can get to where I want to be within 3 or 4 min' and that is cool" (HM4).

Phase five

The fifth phase occurred in the final year of the project with a shift in the direction of the project and targeted the conceptual and pedagogical shifts made by teachers through engagement with material housed on the site. Additional qualitative data about conceptual and pedagogical shifts was also gathered through facilitated on-line discussion with a group of secondary technology student teachers who were completing a graduate diploma in initial teacher education.

The evidence shows that both teachers and student teachers used the Techlink materials to develop their understanding in a variety of ways such as: understanding of National Certificate of Education Achievement (NCEA, New Zealand's senior secondary qualification system) level differentiation, the development of revision checklists, ability to use the site for moderation, further modification of case studies to improve project diagnostic question and answer tools and to identify specific aspects and understandings: "Year 12 and 13 I take them into a computer suite and we go into read the case studies—it is good to show students what is happening out there as well and those case studies I have found useful for developing my knowledge in the level 2 and 3 NCEA externals technological knowledge" (AK4); "This is level one, this is level two—I pull them to pieces, see the difference—see what the students have done. It also gives us an understanding of what other schools are doing as well" (HM4); "I overheard one student getting excited and next heard "look at this" resulting with lots of students trying to view the screen and see what he found on Techlink"(AK4); "To give students an appreciation of what is required for study at the higher levels beyond school I have found Techlink invaluable" (AK4); "Visiting Techlink again has really enthused me and I feel I am really starting to get a grip on how I want to teach technology" (ST4.2- Student Teacher number four in the second round).

The data showed that teachers were using Techlink in a variety of ways and highlighted four distinct themes that contributed to improving their understandings and delivery of effective technology education. Four themes emerged: conceptual understandings of technology, pedagogical practice in technology, components of the curriculum and associated progression and teachers' understandings of their students' perceptions of the curriculum and its implementation. The next section discusses these developed understandings.

Conceptual understanding

Development of teachers' understandings of concepts in technology included building knowledge of technological practice of their students is vital for the successful implementation of technology education (Jones and Moreland 2001). In the data from this study there were several examples where teachers were quite specific about concepts which had been developed through the use of Techlink: "and that is a big thing to actually get your head around that you are going—it's [technological practice] not a linear process like its back to here and back to here and that is half the battle—getting it into your head I think" (CH4); "Very few people had heard of the indicators of progression prior to them going up on Techlink. You know they were out years before that, but it wasn't until they went on Techlink that the shift started to happen and you could take that whether it's the stuff on intellectual property, whether it's the strategies document, whether it's the indicators of progression—everything that goes up on there I see the shift that it makes" (HM4).

Other comments demonstrated that teachers have been able to develop their technological vocabulary and that of their students: "I'm definitely using vocabulary differently and I'm feeling much more confident with the new stuff than what I think I have been in the past—when I'm talking about it" (CH4); "we're using the terminology and processes instantly and that is rubbing off on the students" (CH4).

Teacher understanding of the importance of authentic contexts of learning in the motivation of students was also highlighted it the literature (Hennessy 1993; Turnbull 2002). The data shows that teachers also developed their understanding of the importance of making links to authentic technological practice and their students' possible future pathways: "and so you know the help that they are in creating that link for students to people—technologists in the real world and getting them coming in and helping out and you know as an expert in that particular field, so that's now looking really useful" (CH4); "This one [technological practice case study] also—the Te Papa [Te Papa is New Zealand's national museum in this case study students' developed souvenirs for the onsite shop] one also sort of just highlighted that idea of quality products as well, but they were actually preparing souvenirs for the sort of high stakes client, so it needed to be something that was at that level. It wasn't just something that was being made for mum or dad or you know grandma" (CH4); "visiting factories and technologists takes up such valuable time, plus the fact it is on Techlink reassures me the information is correct and fits the curriculum" (AK4); "Yes, having that real client just sort of intensifies that understanding that what they are doing is actually important and worthwhile" (CH4).

Some teachers commented on the site in a more general way and how it had contributed to their general professional development in technology: "Well, certainly we've used it … we've probably moved on a fair distance from there, but it was a great starting point for us, to actually be able to focus on as a department" (HM4); "For me, like just looking at that, having not taught it last year or this year, I've got a huge amount of work to catch up on. The changes are yes, quite massive" (CH4); "Those case studies are brilliant for scaffolding teachers and students learning" (AK4).

Pedagogical understandings

Findings from the Focus Group Four indicated that teachers used Techlink to develop and enhance their pedagogical understanding. This included understanding of teaching expectations at specific levels, developing a range of teaching strategies and ways to use existing resources: "It was the perfect tool to say go home go on website and look around it, familiarise yourself with it and work around all the resources. I did this with a UK trained teacher and apparently they got so absorbed they missed dinner! They found they really began to see what the NZ Curriculum is all about" (AK4); "I've been working with staff that have been working in tech for a very long time compared to me, but they are still working on the 'manual' [former skills based] concept. So to be able to get them towards the technology concept I looked at the downloads of the whole support document—to be able to pull that out, print off the bits that are relevant" (HM4); "I go on there to see what they do at high school—always on there looking for ideas—recently to help another teacher I was finding resources to assist" (AK4); "I have used case studies with Year 9 [*students aged 13–14*] they loved the spoon biscotti [spoon shaped biscuit]—they are mad about it—when they saw it in the shops they brought one in—it has created a great deal of discussion—that one if particular and some of the New Zealand fashion ones they really like those" (AK4); "I can see I would use this to teach a flow diagram approach to planning, perhaps cut the pictures up with key words and get them to link them

together—what comes first sort of thing" (AK4); "The talk about materials being formed and manipulated is all there and the whole study is very useful for teaching technological process" (AK4). The quotes above were small selection of data collected which illustrated the use of Techlink to enhance the pedagogical approaches applied by teachers. Teachers were using the material to change and enhance their delivery.

Curriculum understandings

The introduction of two new strands to the technology curriculum meant that many teachers were challenged in their understanding of the new curriculum (Compton and Compton 2010). The third theme to emerge from the data was the development of curriculum understandings. This research showed that Techlink facilitated significant shifts in understanding of the curriculum. These include the use of the Indicators of Progression, Teaching Strategies, the curriculum strands and understanding of the achievement objectives at Scholarship ("highest of the secondary school qualification obtained by the top 1–2% of achievers in each curriculum area, Level 4 on the New Zealand Qualification Framework (NZQF) level": "Indicators of Progression on there [Techlink] are absolutely brilliant and initially I was using them looking at the bottom first and did not realise how much there was in it for teacher guidance. I recently used the strategies; I don't know how I missed them" (AK4); "The indicators became my bible and before that the Explanatory Papers. I found after reading about technological systems I had previously had the totally wrong idea but reading the paper made me develope these concepts. The indicators allowed me to see what this looked like for the kids, invaluable" (AK4); "That section with teaching ideas is just fantastic and my colleagues love them too" (AK4).

Student teacher forum discussion

The data from the student teacher section of the study supported the above findings in Phase Four. In addition to this the evidence suggested that student teachers realised the importance of the role of the teacher in motivating students.

Comments indicated that the student teachers gained considerable understanding of their own personal knowledge and skills in technology: "As I look through different parts of this website, I am gaining a broader understanding of what technology is about. It is a place for gaining knowledge, resources and inspiration. I am not there yet but it is a bit of a journey that is continuing" (ST9.2); "The information on the website is broad and offers an overview of what is required. The site is a good introduction to what technology means in schools in 2010 and has provided me with some insights regarding the intentions behind the NZC. *Techlink* is a valuable resource that I will continue to use to develop my understanding of the technology subject" (ST14.2); this visit to the site enhanced my view of technology education "and now I think I am more able and confident to succeed in embracing this new challenge" (ST3.2); "This website has shown me what Technology education "should" be like. It has many resources and case studies that can be applied into technology classes to go along with the NZ Curriculum" (ST20.2); "Having explored the *Techlink* site I now have an appreciation of how the different types of technology have adopted the 2007 NZ Curriculum" (ST15.2).

Some student teachers have used the website to develop a range of teaching ideas, resources and approaches to use with their pupils in the future. Results also indicated that they were inspired by what they were reading and interacting with on the site: "I found these examples quite inspirational. My first thought was that it is probable that it is not the

"kids who can't do that—it is the teacher" (ST11.2); "I have found *Techlink* to be incredibly useful. Activities that actually appear to engage students get them motivated and have a link component that connects them to the "real" world. Putting themselves (the students) into projects is crucial for developing the "link" which is what *Techlink* is showing" (ST19.2); "The thing that struck me about all of these examples were that they were driven from the student's interest and so while a teacher might say my students can't do this, they will be able to do something else they are interested in" (ST2.2);"The site is an amazing source of inspiration and has so many and varied ideas that can be used to create a fun and exciting program in technology for teachers and students"(ST7.2); "I was not aware that students could interact with businesses and clients in developing projects like this. The really showed the key competencies as opposed to students just reading and exercises out of a book" (ST8.2).

A number of comments from student teachers indicated they recognised that teacher motivation, enthusiasm and drive are critical to the achievement of their pupils: "I think the examples show how important it is to give it a go, and through support and motivation students will and can achieve" (ST6.2); "These projects involve a great deal of commitment on behalf of the teacher—much more than "follow the recipe" and "fill in the gaps on the handout". The teacher has to organise field trips, support the students in seeking expert advice or do it themselves. The students must be supported to work independently and stay on task" (ST14.2); "I agree … that buy in from the students is an essential part of a successful project" (ST7.2); "In my view the teacher's motivation and willingness has the biggest impact on this" (ST11.2). Some students used the site to influence other teachers' practice during their practicum, "I introduced the HoD [Head of Department] of my practicum school to the Techlink site and he was most impressed. Hopefully he'll get some idea of what can be achieved if he continues to visit it. I was surprised he did not know about it already. In future, anyone telling me that the kids "are not ready for this," will be introduced to the Techlink website with the comment, "Well, this is what they're doing in Year 9 at this school!"" (ST13.2).

The above section suggests that modifications to Techlink affected a positive change in the way teachers use the materials to improve both their understanding and teaching and their students' learning.

Conclusion

This study shows that through the use of responsive evaluation resources used by teachers to support the delivery of technology education in New Zealand were enhanced and proved to be better used by and more effective for teachers.

The evidence presented in this article also indicates that teachers who regularly engaged with the Techlink site made significant gains in their conceptual and pedagogical understanding of technology education. Teachers clearly appreciated the changes and enhancements made to the site during the duration of this research project. Focus group participants appeared to be regularly engaged with the site for their own personal use and to assist their colleagues and department members. Student teachers have also gained technological conceptual and pedagogical knowledge. Active participants increased their knowledge and understanding of the technology curriculum and its components. Student teachers have also gained an understanding of the importance of the role of the technology teacher in motivating their students and assisting to achieve.

This research is significant because it deals with the development of an online nationwide resource for technology education. With the recent implementation of technology education as part of the New Zealand curriculum teachers have struggled to find resources that are contextually situated, relevant to their students and specifically linked to The New Zealand Curriculum-technology. (Ministry of Education 2007). The New Zealand experience leads us to believe that a central website populated with research informed quality controlled up-to-date curriculum material can be an excellent resource for developing common content and pedagogical understandings within technology education.

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